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# A Lecture about the Water Supply and Sewerage of San Francisco

delivered before the Cooper Medical College and Lane Hospital, February 16 1900, by Dr. Charles N. Ellinwood

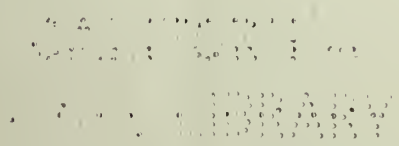
SPRING VALLEY WATER WORKS BUILDING,

# SAN FRANCISCO'S
# WATER SUPPLY AND SEWERAGE

BY

CHARLES N. ELLINWOOD, M. D.

WITH ILLUSTRATIONS OF
THE SPRING VALLEY WATER WORKS



LECTURE AT COOPER MEDICAL COLLEGE

February 16, 1900

THE CRYSTAL SPRINGS DAM.

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# SAN FRANCISCO'S

# WATER SUPPLY AND SEWERAGE.

The civilized world has awakened to the fact that a bountiful supply of pure water is an essential factor in man's existence.

Populous cities, tribes and races of men, have, in the evolution of time, arisen and occupied prominent places in history; and their passing, leaving only dim tracings of their existence, has been a mystery only solved in these latter years by the study of disease and the triumph of medical science in the discovery of the causes of infection and the methods of its propagation and dissemination.

We wonder in amazement that the sacrifice of so many millions of lives in the plague-spots of the world should have been repeated age after age and yet the mystery remain unsolved; that only to-day are man's invisible foes revealed and their vanquishment made possible.

To this end a great war has been inaugurated, the most humane, the most comprehensive in its inception, the most beneficent in its results. It commands the alliance, offensive and defensive, of all governments and of every people of the world, on one side; and on the other, man's destroyer, disease germs, which infest the atmosphere, the water and food products on which man's life depends,—a gigantic battle-field extending over the earth's surface—a battle involving in its issue more lives

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THE TOP OF CRYSTAL SPRINGS DAM — SHOWING THE METHOD OF BLOCKING.

than have been sacrificed in all other battles since the beginning of time.

There is now an organized effort being made by an organized army of scientists and humanitarians of North America to prevent the pollution of the surface water of streams, rivers, and watersheds, by stopping the pernicious practice of flowing sewage upon them.

Sanitary legislation is being asked of our Government at Washington and also of the Government of Canada for the suppression of this growing evil, by which many thousands of lives are being sacrificed, and the gravity of the situation is increasing daily, even jeopardizing the most populous regions of the continent.

The problem is presenting itself on a large scale at the present moment, by the opening of the Chicago canal, by which the entire sewage of that great city, thousands of tons daily, are carried into rivers flowing into the Mississippi River, on which great stream St. Louis and many other cities depend for their water supply for domestic and other uses.

Millions of dollars have been spent by Chicago in the construction of this great sewer canal, of incalculable benefit undoubtedly to the denizens of Chicago, but of incalculable destruction to those unfortunate inhabitants living on the banks of the rivers receiving this pollution, all the way down to New Orleans.

The State of Missouri questions the right of her neighbor, the State of Illinois, to send her filth down the stream to her, and the General Government is called upon to abate the nuisance.

The same problem is being presented in nearly all the rivers of this continent, and also in Europe as well.

As the population becomes more dense the pollution of the water by sewage increases, and those cities which are dependent upon rivers and public waterways for their supply of potable water, suffer from the contamination as

THE CRYSTAL SPRINGS DAM — SHOWING OVERFLOW.

a consequence. The sewage from towns, cities, camps and aggregations of people and of animals is the great factor in that virulent pollution of water, carrying with it the germs of disease and death.

It is to be hoped that some efficient ways and means may be found to overcome this great obstacle to human progress and longevity.

The organization of the American Water Works Association is a very promising effort in that line of research and experiment. Guided by men of eminent abilities and philanthropic motives, it is believed that they may arrive at the practical solution of this great problem.

Water, as we find it in nature, is never pure. It is contaminated by impurities derived from the air in which it floats as cloud and through which it falls as rain, and from the rocks and soil over and through which it passes on its way to the streams; but these impurities, if unmixed with decay and sewage, are usually harmless to man.

Rain water contains but a small portion of mineral matter with a considerable proportion of organic matter.

Upland surface water or mountain water contains a much larger proportion of both mineral and organic matter, the mineral water differing greatly in different localities by reason of the varying geological formations of the watershed, the nature and amount of mineral impurities depending upon the soluble constituents of the rock. Shallow well water is contaminated by the greatest amount of impurities of both organic and inorganic matter, as such wells are dug for convenience near the dwellings they are intended to supply, and naturally get the seepage water as it percolates through the soil, carrying with it the mineral, and also the organic matter, vegetable and animal, undergoing decomposition and solution.

Such shallow well water is usually bright, clear and sparkling, and also palatable, but, alas, is most apt to carry pathogenic germs of disease, such as typhoid fever,

THE CRYSTAL SPRINGS DAM — AS SEEN FROM THE LAKE.

and should be avoided whenever possible. In deep wells, say of a hundred feet or more, the organic matter disappears practically from the water by a process of oxydation and purification as it slowly filters through the great depth of earth.

San Francisco is greatly favored in its water supply, if we make a comparison with that of other large cities of the world. I am not unmindful of the occasional objections, and even loud complaints, against Spring Valley water. Such complaints were formerly much more common, and deservedly so, than now. But before I tell you what I have seen of the water, and the sources of the water which the Spring Valley Water Works supplies to the people of this city, let us take a rapid glance at the conditions of the water supply in other cities.

In the numerous reports of the Royal Commissioners of the Water Supply of London I find some interesting facts, viz : In 1581 Peter Moreys obtained permission to build a water-wheel under one of the arches of London Bridge, to supply a portion of the city with water, and the pumps were operated by the tides. For about 200 years, a considerable supply of water was obtained in this way, pumped from the Thames River at London Bridge.

Of course, the water at that time could not have been such a terribly polluted stream as in these latter times, or London would not have survived with such a water supply. But even now the great question of a pure water supply for that metropolis is not satisfactorily solved, and only a scant quantity of impure water is furnished to its inhabitants.

The city of Berlin gets its water from the River Spree, which has become so polluted by sewage from the populated districts on its watershed that 80,000 to 90,000 micro-organisms can be counted in a cubic centimeter (fifteen drops) of its water, and recently I have seen it

THE SMALL LAKE MADE BY THE STONE DAM
BELOW PILARCITOS LAKE.

stated that a process of sterilization has been resorted to at Berlin by which the water is forced over a series of small falls for aeration, and during the passage it is subjected to a current charged with ozone. Ozone is oxygen in an active state, which destroys, by oxygenation, the micro-organisms to such an extent as to render the water potable.

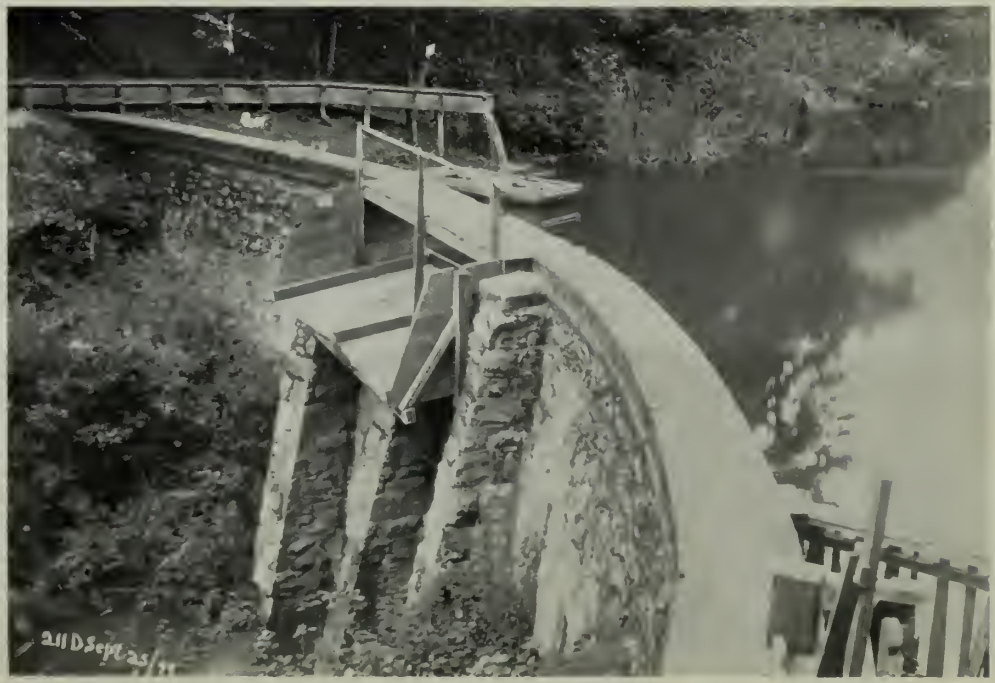
Hamburg, but a short time since, suffered from a frightful epidemic of cholera from its polluted water supply, due to the flow of sewage into the river which the inhabitants were obliged to use.

Philadelphia has in the past two or three years lost more valuable lives from typhoid fever and at greater cost to the State and Nation than has been sustained by our Spanish war, and all this simply by the sewage pollution of her water supply.

New York, New Orleans, and Washington even, are struggling with this same impending danger of infection from their water supply.

Chicago, if I may be allowed to again refer more particularly to her canal, has spent $33,000,000 in the construction of a drainage canal to divert from the city its sewage and to remove from its water supply this potent source of pollution. This is the largest sanitary enterprise which has ever been completed in the history of the world.

This drainage canal is 160 feet wide at the bottom and is 38 feet deep, and will carry all the sewage which flows from the city into the Chicago River, and which has heretofore remained there or flowed into Lake Michigan. Now, through this great canal it will pass down by natural waterways to the Mississippi River. The water flowing through this canal from Lake Michigan through the Chicago River is said to be 10,000 cubic feet per second, which is about five per cent. of the amount of water flowing through the Niagara River, and is sufficient



THE STONE DAM.

to raise the low-water mark one foot in the Mississippi River at St. Louis.

This gigantic enterprise must vastly improve the sanitary conditions of Chicago, and save yearly thousands of its inhabitants from preventable diseases and death, serving the two all-important purposes of removing all the sewage from the city and also permitting the supply of reasonably pure water from Lake Michigan contiguous to their intake pipe.

But while this achievement is such a boon to Chicago, yet St. Louis is a sufferer by having this immense amount of Chicago sewage added to the already polluted water of the Mississippi River, from which stream her water supply is drawn. Of course many other cities along the Mississippi are equally interested with St. Louis in this question, and the courts of justice are being called upon to settle it, and it may be in the end that engineers will find a way to flow this now dreaded sewage waste on to tillable lands, to fertilize them, to keep them ever productive, and in such a way as not to pollute the natural waterways of the continent.

After this cursory survey of the subject in general, let us look at home, for our individual interests and welfare. My inquiries and study of San Francisco's water supply have astonished me with the fact that very few people, comparatively, manifest any particular interest in the subject other than the financial side of it.

Through the courtesy of the officers of the Spring Valley Water Works I have been able to view, aided by intelligent guides, the various and extensive watersheds and works by which this city is well supplied with good, wholesome water, free from all such sewage pollutions as many cities suffer from, situated on navigable rivers, or getting their water supply from such a source.

The growth of the water-works on this peninsula, from a small beginning in 1854 to its present gigantic and

SUBTERRANEAN WATER DEVELOPED AT SUNOL.

perfected establishment, is truly a marvel in the history of such enterprises, and reflects honor upon its promoters, for their far-seeing wisdom, courage, and skill.

The operations of the water company in the storage of water for the city commenced with Pilarcitos reservoir, and one after another San Andreas, Crystal Springs, and Lake Merced were acquired. Their watersheds cleared as far as possible from contaminating causes, and extensive, solid, and admirable works erected for the economic storage and distribution of the water so provided for, and to which system has been added in these recent years that very important acquisition of that vast watershed, the area of which extends from Mt. Hamilton to Mt. Diablo, which yields a generous flow of clear, sparkling, well-filtered, and consequently pure water at Sunol, where it is protected from surface water contaminations and thence conducted in permanently established flume and pipe lines directly to the company's reservoirs in this city.

My excursion to Lake Merced, a few weeks ago, was a delight and a surprise to me. Common report has always been adverse to the availability of Lake Merced as a source of our water supply, and I am free to confess that I fully sympathized with that sentiment from personal observations made some years ago in trying to get around, over, or through the salt marshes or sloughs, where hogs were wont to wallow in the bordering territory of this lagoon. Then it was a filthy pool collecting the decaying organic matter from the peninsula of which it was a receptacle and at high tide getting an inflow of salt water from the sea, conditions well calculated to make a lasting impression of the non-potable character of Lake Merced water. But now how changed!

By the fortuitous combination of two all-important events the water of the lake has become a large and important source of our water supply.

SUBTERRANEAN WATER DEVELOPED AT SUNOL.

First—The Pacific Ocean, during the past few years, has kindly washed up from the beach its golden sands, and aided by the summer winds a perfect barrier has been built against the inflowing salt water from the sea, and thus that source of impurity has been removed.

Second—A threatened water famine in 1877 convinced the Spring Valley Water Works that this water must be utilized, and so at great expense and engineering skill it constructed drainage canals, by which the polluting surface filth is entirely diverted from the lake by a long brick aqueduct and tunnel and carried directly to the ocean.

The company now owns and can forever control this large area of watershed, and these circumstances have transformed Lake Merced from a filthy pool of a salt marsh and lagoon, which it formerly was, into a very important source of the good potable water supply of our city, comparing favorably in the recent analysis made by the Board of Health with the other sources on the peninsula.

With the experience gained at Lake Merced, the successful diversion of surface impurities from flowing into and polluting the water of the lake illustrates the practicability of applying the same methods to all the many hundred square miles of watershed now owned or controlled by the Spring Valley Water Works, and its ability to furnish an abundant supply of potable water for a million or more of thirsty inhabitants.

The recent acquisition and development of the immense watershed in Alameda County is, to my mind, the most interesting and admirable crowning work of the Spring Valley Water Works. To the penetrating vision of its engineer, Mr. Schussler, is due the discovery of a large subterranean lake, fed by hundreds of square miles of watershed, which has been successfully tapped at Sunol, and from which a large flow of delightfully pure water is seen to issue from its deep gravel formation.

OPENING CUT FOR SUBTERRANEAN FILTER AQUEDUCT.

This subterranean lake is secure from sewage pollution and capable of being drawn from at the will and skill of the engineer as the wants of the city may demand.

We look with wonder and admiration at nature's handiwork in providing these beautiful hills and valleys, so marvelously adapted to the purification and storing up a generous water supply in such close proximity to our favored city.

Mother Nature, in all her kindness and with such fostering care as no human forethought could have devised, has so planted these hills and so arranged the substrata of the valleys as to conduct to a secure and safe reservoir the falling rains from cloudland and have them there at the command of man, ready to serve his most beneficent uses.

The experience of the past years has convinced the presiding intelligence of the Spring Valley Water Works that it should have a storage capacity equal to a three years' water supply. The immense watershed, embracing the hills and valleys, reaching from Mt. Diablo to Mt. Hamilton, added to the several lakes and numerous reservoirs in the city proper and in San Mateo County, enables it to secure and hold, beyond peradventure, an ample supply to meet all necessities of the city and avert all danger of a water famine.

To be convinced of the capability of the Spring Valley Water Works to collect and impound an immense store of water for its future wants one need only to spend a few days in exploring the hundreds of square miles of watershed which the company owns and controls, embracing the hills and valleys of a large portion of Alameda, Santa Clara, and Contra Costa counties, and the extensive watersheds on the peninsula which can be made tributary to the Crystal Springs, San Andreas, Pilarcitos, and Merced lakes. And finally, its distributing reservoirs, nine in number, so unobtrusively located in the various sections of the city, and so quietly doing their beneficent

SHOWING FILTER PIPES, SUBTERRANEAN AQUEDUCTS AND GRAVEL FILTER IN PREPARATION.

work of receiving, holding and giving out their many hundreds of millions of gallons of water just whenever we hundreds of thousands of people open our little faucets and get an ample supply of water, always ready, to meet our necessities.

These immense reservoirs are so wisely planned and placed at the various necessary altitudes that they supply the various districts of high hills and low lands of the city under a pressure equal to all emergencies, that of extinguishing fires and flushing sewers being of great importance.

It may not be known to many of you how the quality of our Spring Valley water is improved and purified by its manipulation, by screens and aeration processes and the agitation and pressure to which it is subjected in traveling its many miles of pipes and conduits before it reaches the consumer.

But such is the interesting fact, and without going into any tedious details let me give you a single example of the many scientific observations which have been made to determine this, and which show that the more constant the agitation and aeration to which the water is subjected the freer it is of the contamination called bacteria; e. g., water taken from the San Andreas lake after it has passed through a screen which removes some of its vegetable matter, yet contains 1640 colonies of bacteria to the cubic centimeter, or 15 drops.

Now, if we follow this water from San Andreas we find that it flows through a thirty-inch pipe sixteen miles long and is subjected to a 340-foot pressure, and on arrival at the College Hill reservoir it has lost one-half of its bacteria; i. e., leaving only 800 colonies in the cubic centimeter; and finally this water undergoes a further process of aeration, by which its bacteria are again reduced, leaving only 290 colonies in the cubic centimeter.

SHOWING THE FILTER PIPES IN THE CONCRETE, SUBTERRANEAN AQUEDUCT.

The same results are obtained in the microscopic tests of all the reservoirs of the company ; i. e., there is a constant diminution in the bacteria as the water is subjected to the purifying processes, a result which is very desirable—for while a few of these innocent bacteria are by no means injurious and should not deter us from drinking plenty of water, yet as an exclusive diet we might find valid objections.

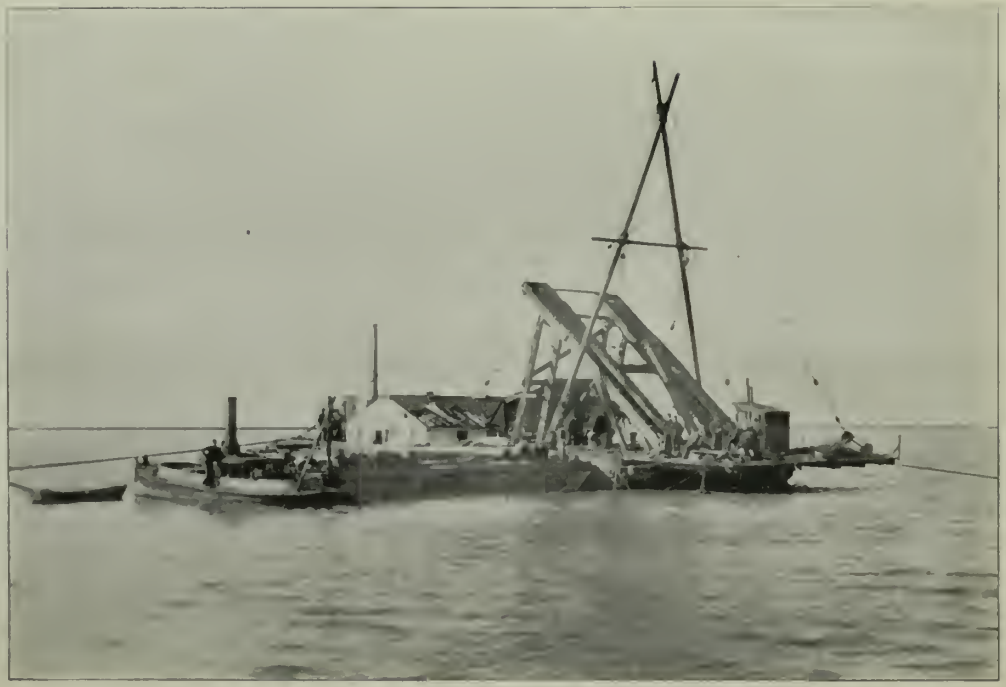
Water drawn from the faucet in Cooper Medical College laboratory shows from 300 to 400 bacteria in the cubic centimeter, and this is a fair average of the purity of water throughout the city, and compares very favorably with the water supply in the most favored cities in the world.

These observations were made by the Board of Health, and published last month. Their analyses show that the purification of the water from this vegetable growth in its transmission from San Andreas to College Hill is accomplished to the extent of the difference between 1640 at the lake to 290 at the reservoir.

Still further improvements can certainly be made, and are now engaging the earnest consideration of the water company, which will find, I believe, the final solution of this difficulty in the removal of all vegetable growth from the watershed, as far as possible divesting it of decaying leaves, grass and shrubs, which now furnish the pabulum for the growth of those numerous algæ you observe in the still water of the reservoirs, and notably in the water-tanks of our city houses.

If it is possible, in other words, to protect the watershed from the decay and solution of vegetable growths, we render the water safe from further contamination by impounding it in the lakes, or its storage in our reservoirs and individual water-tanks.

The analyses of the water from all the sources of supply of the Spring Valley Water Works show a remarkable



LAYING SUBMARINE PIPES ACROSS THE BAY OF SAN FRANCISCO, FROM DUMBARTON POINT TO RAVENSWOOD

absence of all pathogenic organisms or specific disease-producing germs, like typhoid or tubercular bacilli, from which we find that we are perfectly safe in drinking Spring Valley water, and, in fact, I believe the average of city residents, people of sedentary habits, generally, ought to drink more water than they do.

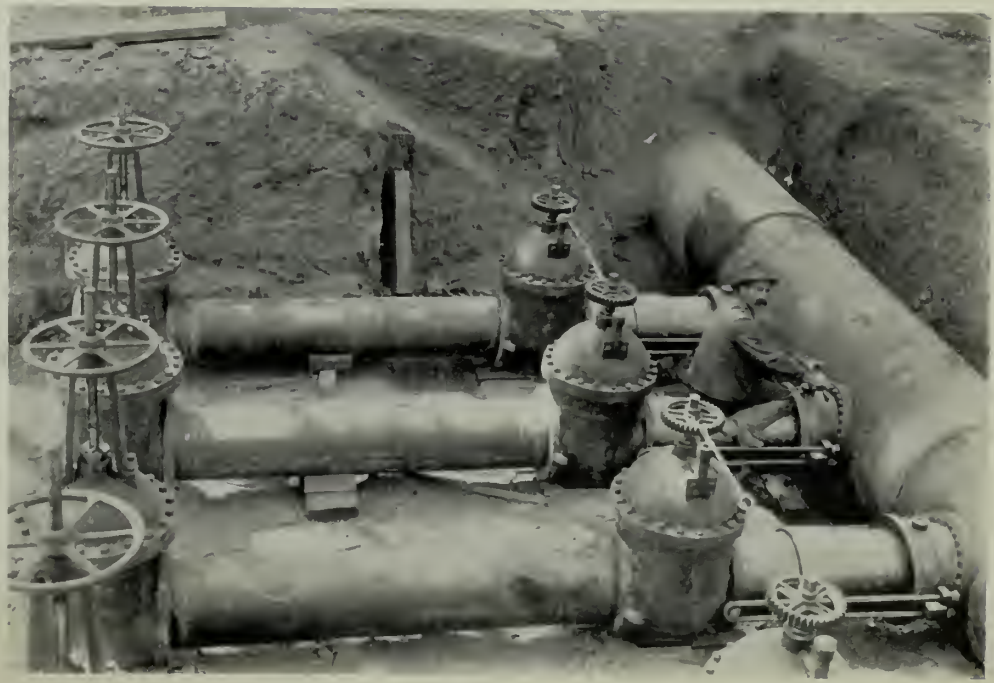
The suggestion here presented of how best to prepare and protect a watershed from contaminating causes is one of incalculable importance when you consider the consequences of neglect which may jeopardize the health and lives of a million people. The solicitude of the water company is alive to this problem, and I feel assured that every precaution will be taken to keep the water pure and free as possible from all harmful contaminations.

The microscopic examination of the water from the subterranean lake, at Sunol, shows only twenty to forty bacteria to the cubic centimeter, which is the most remarkable instance of a natural water in all its purity that I know of, and this freedom from organic matter is undoubtedly due to the perfect filtration to which it is subjected in reaching and passing through the subterranean gravel formation.

### CALAVERAS RESERVOIR, PROVISION FOR THE FUTURE.

Looking far ahead to the time when San Francisco shall have a couple of millions of inhabitants to be supplied with water, the Spring Valley Company has secured another site for an artificial lake, the Calaveras reservoir, some ten miles south of Sunol, with a watershed of 140 square miles tributary to it, which is estimated to yield 30,000,000 gallons in all ordinary years of rainfall.

The elevation of the outlet of this auxiliary reservoir, as planned, will be 600 feet above tide-water and fifty miles from the city, so that nearly the whole city can be supplied from it by gravitation, or its water can be made



SHOWING THE CONNECTION OF MILLBRAE PUMPS WITH THE 44-INCH CRYSTAL SPRINGS MAIN.

to gravitate into San Andreas and Crystal Springs Lakes, situated on the peninsula about twenty-five miles south of San Francisco.

Thus it will be seen that the water supply of San Francisco is, happily, well provided for in ample quantity and of vastly superior quality to that of other cities of this continent, and of Europe as well, where usually their water supply is drawn from navigable streams, with a dense population on their watersheds, polluting them by draining their sewage into the passing current.

So far our investigations justify the conviction that by the co-operation of the rainfall, the watershed, and the impounding capacity of the Spring Valley Water Works, San Francisco is generously provided with water for all present needs, and a liberal provision has been made to meet its further demands.

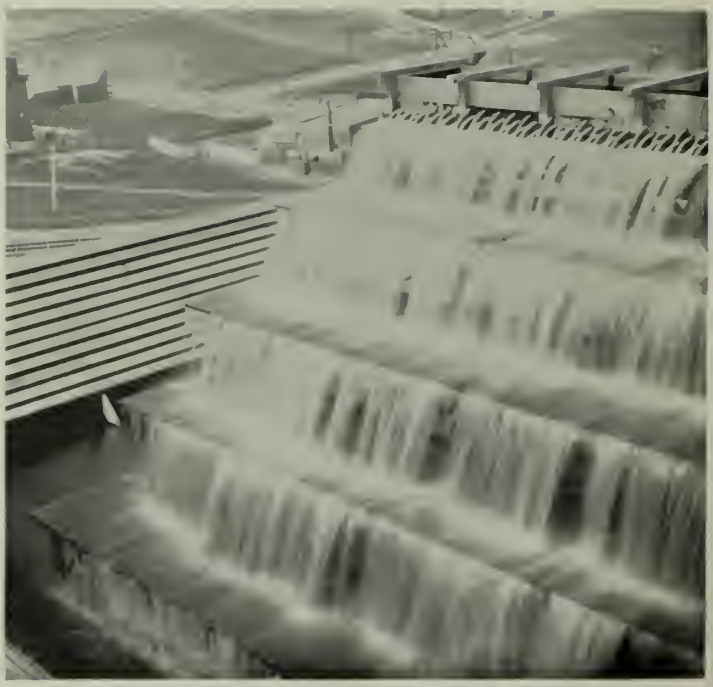
PER CAPITA DAILY CONSUMPTION.

About eighty gallons per day per individual is the present consumption of water, which, if necessary, could be reduced by stopping waste and extravagant use to one-half that per-capita allowance, and so insure an ample supply of potable water for two millions of people.

A further economy of our potable water supply has been with much good reason suggested in connection with the construction of the new system of sewerage which has been recently provided for by a popular vote, and which it is hoped may soon materialize.

If in that good work it can be so planned as to utilize the salt water from the sea for the flushing of sewers, the extinguishing of fires, the sprinkling of streets, and for private and public baths, then certainly a great saving of the potable water in the reservoirs can be accomplished thereby.

For sanitary considerations, as well as for the economy of our potable water supply, it is believed that the intro-



SHOWING DETAILS OF AERATOR AT COLLEGE HILL RESERVOIR.

duction of salt sea water will add to the efficiency of the sewers in forever ridding the city of North Beach nuisances, the Butchertown stench, and all such filth accumulations and causes of preventable diseases.

It is truly an outrageous criminal negligence that this city, so favorably located for perfect cleanliness and sanitation, should have been allowed to struggle on through all these years with filth diseases and a preventable mortality at such great cost of life and money.

The proposed new sewers, constructed on modern principles, common sense, and integrity, will, I trust, give us a pure atmosphere to breathe and more years to live, and oblige us to thank our lucky stars that our lot has been cast on this particular shore of the great Pacific Ocean.

GENERAL VIEW OF AERATOR AT COLLEGE HILL RESERVOIR.

# REPORT

—OF—

# J. D. SCHUYLER, C. E.

ON THE

## Probable Cost of the Construction

OF THE

# CONTRA COSTA WATER WORKS.

# REPORT

—OF—

# J. D. SCHUYLER, Civil Engineer.

—ON—

# CONTRA COSTA WATER WORKS.

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*The President and Board of Directors Contra Costa Water Company, Oakland Cal.,* GENTLEMEN:

At your request I have made surveys and detailed examinations of your works for the water supply of Oakland and of the records, maps and notes on file in your office relating to their construction, with the purpose of estimating their probable cost, and deducing therefrom their present value. The surveys were principally made under my supervision by W. F. Boardman, an Engineer of repute, whose familiarity with the works extends back to their commencement, and whose notes of special surveys made at the time the construction of the dam was in progress have been of material assistance in making my calculations. The lack of systematic records of the character and cost of materials and labor in the earlier years of construction, and the almost utter absence of detailed plans and drawings have made the task of arriving at a fair estimate of the amount of work done in places now inaccessible, a difficult one, and the difficulties have been increased by

the necessity of fixing a valuation upon the work under the fluctuating scale of prices of materials and labor in the period from 1868 to the present time. Under those conditions it is quite evident that no two engineers would exactly agree in their estimate of work determined in this necessarily hypothetical manner. My own experience in constructions of a similar character has taught me that a much larger margin must be allowed for unforseen accidents, delays and contingent expenses than would seem possible or probable looking at the work either before or after construction. This is especially true in all excavations or embankments where water is encountered and must be disposed of. I have consulted all those whom I could find who had a part in the construction of the dams and the manufacturing and laying of the main supply pipes, and from all sources have gained all information I could possibly obtain to throw light upon the subject. Your President, Mr. A. Chabot, who planned all of the works and directed their construction, has given me much detailed information, which, in so many points, has been corroborated by outside testimony and positive measurement, that I have accepted it as correct in nearly every particular. His recollections of dimensions and details is remarkably clear and accurate.

Reports were made to the City Council of Oakland dated Aug. 18th. 1874, Jany. 13th, 1875, and Oct. 12th, 1875, by T. J. Arnold, City Engineer, in which much valuable information as to the construction of the San Leandro Dam and mains, is given. These have also been consulted.

## DESCRIPTION OF THE WORKS.

Oakland was but a village when in 1868 Mr. Chabot first introduced water into the streets by a pipe line laid from the bed of Temescal Creek, some three miles

8491

away, but its promise of growth was such that it seemed to warrant the construction of a reservoir of moderate dimensions for impounding water, and in the spring of the same year the Temescal Dam was begun at a point 4½ miles Northeast of the City. A point was selected some 500 feet above the present site of the dam, but after building heavy masonry arches of cut stone for a waste way, and excavating for a puddle-wall, the bottom proved defective and the work was abandoned after expending some $15,000. The present site was then selected and the dam built to a height of 105 feet, above the Creek bed, or 427 feet above Oakland base, with a top width of 18 feet, and slopes of about 2½ to 1 on both sides, which have since been increased from year to year by sluicing in material from the hillsides, by means of ditches that run full for a few days after heavy storms.

The area of the high water surface of the reservoir is 16½ acres, its *maximum capacity* is estimated at *188,874,000 gallons*, and the water shed tributary to it at 1500 acres or 2.34 sq. miles. Numerous accidents have been described to me as occurring during the construction, and subsequently, which have entailed expense, one of which was a landslide that over-toppled the heavy brick tower in the lake, in which the regulating gates were placed.

About the same time that the Temescal reservoir was under construction the small *distributing reservoir* near McClure's Military Academy on Hawthorne street was built. Its elevation is 100 feet above Oakland base, and it is supplied from the Temescal reservoir.

The water from the Temescal reservoir is now used for the supply of Piedmont, Temescal and other high suburbs of the City; a portion of it is supplied to the *Highland Park Reservoir*, which was built in 1870 at an elevation of 206 feet above City base. The latter

reservoir is chiefly supplied, however, from the Sansal Creek, a small stream passing through Fruit Vale. It has a capacity of 500,000 gallons, and is supplemented in the summer and fall, when other sources run short, by water pumped some 6,000 feet, from large artesian wells, bored near this level in 1871.

As the city increased in population and the demand for water began to tax the capacity of the works then in existence, Mr. Chabot in 1870, sought a larger source of supply where a reservoir might be constructed whose capacity would be practically unlimited, as the small water shed of the Temescal reservoir warranted no further increase in the dimensions of the dam, and extension of supply in that direction was impracticable. From surveys made in 1870 for this Company of the water shed of the San Leandro Creek, it was ascertained that its area was 50 square miles, the fall of the stream comparatively slight, allowing large areas to be flooded by a dam of practical height, and that all conditions were favorable to such a construction as Mr. Chabot had in view, including material suitable for the embankment in quantities, at a narrow point between two high hills, and at a convenient distance from the city.

All these advantages decided the selection, and the Company at once set about the purchase of the necessary land to cover the site of the reservoir and as much of the water-shed as was necessary to protect the waters from pollution.

By Mr. Chabot's wise forethought in inaugurating the works for this supply, an impending water famine in Oakland was averted and an unlimited supply secured for the future.

The construction of the San Leandro dam was begun in the summer of 1874 at a point 1½ miles above the village of San Leandro, and 9½ miles southeasterly from Oakland, where the creek bed had an elevation of 115

feet above Oakland base, and the width between the hills at a height 115 feet above was but 400 feet. The work was continuously proseeuted until in the fall of 1875 the dam had reached a height of 215 feet above base; the mains were laid and the water turned into the eity. The dam has since been earried 17 feet higher, and its crest is now 232 feet above eity base.

The elevation of the water surface at the time our surveys were made was 222.7 feet above city base, at whieh height the reservoir contained 4,323,446,500 gallons, above the mouth of the outlet tunnel.

The building of the dam was attended by many expensive accidents, to which all constructions of that magnitude are liable, neeessitating many ehanges of plans and the expenditure of labor and money which are not now apparent from a casual inspeetion. Work was earried on continuously during a severe rainy season. The seamy and permeable eharacter of the rock on the westerly spur or point whieh is pierced by the outlet and overflow tunnels and wasteway, required a large amount of masonry and concrete wall to prevent leakage, whieh might endanger the safety of the dam.

The embankment is built with a puddle-wall of selected clay in the eenter, 90 feet wide at the bottom, extending down 10 to 30 feet below the surfaee, the treneh being lined with eoncrete, and grooves or trenches in two, and sometimes three parallel lines, being eut in the solid rock beneath the bottom of the puddle-wall and filled with eonerete to prevent all possible leakage. After the puddle-wall had reached the natural surfaee of the ground, the entire dam was built up in layers and with equal eare, the only differenee between the puddle-wall and the remainder of the embankment being that choicer material was seleeted for deposit on the center of the dam. Praetically, then, it may be said to be all puddled, with the exeeption of that portion put in by

sluicing. Every effort seems to have been made to attain absolute stability of the dam, and it conveys to any one looking at it a sense of perfect security. The slopes are built in steps or benches, and are generally about 2½ feet horizontal to 1 foot vertical, on each side. The embankment was principally built with carts and horses, the material being spread in thin layers, constantly wet down with hose supplied by steam pump, and compacted by means of horses in gangs tied together, driven back and forward over it—a method preferred to that of rolling. After the embankment had reached a considerable height the slopes were reinforced by material sluiced in by water brought in a ditch and flume 4 miles long. This was only done, however, for a few weeks each year during the rainy season. Nevertheless it formed an important factor in cheapening the cost, as the material thus transported was placed in the dam at about one-fourth to one-fifth of the cost of handling by carts or excavators. I estimated that the total amount of material thus handled was about 100,000 cub. yds., and I based my estimates upon the measured capacity of the ditch, the average length of time each season that sluicing was done, and the average duty of water used in the mines of California for sluicing similar material. The amount of water used in sluicing was about 10 to 15 cub. feet per second (400 to 600 miner's inches), the duty of the miner's inch being about 2 cub. yds. per 24 hours.

As planned, the dam will ultimately be carried 75 feet higher when its capacity will be about 15,000 million gallons, or almost 5 years' supply at the rate of the greatest daily consumption thus far recorded.

To keep pace with the probable future growth of the city, Mr. Chabot has looked forward to a still further increase of the supply, and has secured for the Company a tract of land in the *Pleasanton Valley,* covering a

valuable water right. Considerable work has been already done in digging a canal to drain the lagoon formed by the large springs on the tract, and the surveys have demonstrated that a canal line to lead the water from this source into San Leandro Lake is quite feasible.

Considerable work was done toward the improvement of the system during the past year; the dam was raised some 17 feet, the wasteways and masonry breast walls were carried up to correspond; 13,012 feet of the 24-inch main were taken up and 5 632 feet of it were relaid from the dam westward, making a double line of 24-inch main for that distance, from the end of which a 37½ inch main was laid a distance of 25,314 feet, to High street. It was found on taking up the 24-inch main, that where it had been laid in adobe soil, the asphaltum coating had been almost entirely absorbed, and the iron considerably corroded. To avoid a repetiton of that destructive action the new 37½-inch main was surrounded with sand in the trench, 6 inches to 12 inches in depth to prevent contact with adobe soil—the sand being hauled several miles.

In presenting my estimate of the probable cost of the works I am aware that some of the prices which I have assumed will be subject to criticism because they are so largely in excess of the current prices of to-day. This remark will chiefly apply to my estimate of the cost of the 24-inch main from San Leandro dam to Fruit Vale, 38,420 feet in length. It must be borne in mind, however, that this pipe was manufactured at a time when iron was at its highest market price, that it was made by hand, when hydraulic machinery was not in use, and that it is a more costly pipe to lay than the larger sizes on account of the difficulty of getting into it to do the riveting in the trench. For the first mile from the dam heavy rock cutting on the face of high bluffs was nec-

essary to prepare the level bench for the roadway, and the trench was afterwards cut into and below the level thus established. The prices of brickwork are high on account of a scarcity of brick in the market, produced by the large demand for the Palace Hotel, then in process of erection.

As for the prices on earthwork of that class, I consider those used in my estimate to be fair and reasonable, In my judgment they are not in excess of what would be bid for the work by any intelligent contractor, with labor at the prices ruling in 1874-5.

Following is a summary of my estimate of the probable cost of the works:

ESTIMATE.

| | | |
|---|---|---|
| San Leandro Reservoir | $ | 813,851 90 |
| Temescal " | | 305,043 25 |
| McClure " | | 7,600 00 |
| Highland Park | | 6,625 00 |
| Pumping Works, East Oakland | | 20,000 00 |
| Total Pipe Distributing System, including cocks, gates, crosses, tees, etc | | 1,706,248 09 |
| Real Estate, including Sausal Reservoir and Water-rights | | 170,241 00 |
| Engineering, Superintendence, Legal Expenses and Contingencies | | 100,000 00 |
| Stock on hand | | 65,000 00 |
| Total | $ | 3,194,609 24 |

In this estimate nothing has been added for cost of water-rights, which on the Temescal and San Leandro Creek have been expensive.

I append herewith detailed estimates of the cost of the work. They have been carefully considered, and I believe them in my judgment to be as nearly correct as it is possible to arrive at them without more exact data than has been placed at my disposal.

Respectfully submitted.

J. D. SCHUYLER, Civil Engineer.

# ESTIMATED PROBABLE COST
## OF CONTRA COSTA WATER CO.'S WORKS.

### SAN LEANDRO RESERVOIR.

| | | | |
|---|---|---|---|
| Buildings and general improvements past and present | | $ 14,000.00 | 2000 — |
| Grubbing and clearing 7.4 acres under Dam at $90 | | 666.00 | 200 — |
| Stripping surface, soil, loose rock, &c., 322,500 superficial ft. average 3 in. deep ~~at 60c~~ 30 | | 21,499.20 | 10740 — |
| Excavation for Puddle-wall—16,030 cub. yds. loose rock at ~~$1.00~~ 50 | | 16,030.00 | 8015 — |
| Concrete plaster on bottom and lower side of puddle trench, and small sub-trenches filled with concrete 1,409 cub. yds. at $9. ~~$7.~~ | | 12,681.00 | 9863 — |
| Puddle-wall best selected clay, handled three times, spread in thin layers, wet down, and compacted 82,976 cub. yds. at ~~$1.50~~ 1.25 | | 124,464.00 | 82976 — |
| Main embankment 421,709 cub. yds.—viz: | | | |
| 299,709 cub. yds. by carts at ~~$1.00~~ 50 | $299,700.00 | | 149850 — |
| 122,000 cub. yds. sluiced at ~~25c~~ 10 | 30,500.00 | 330,200.00 | 12200 — |
| Catch basin embankment 38,026 cub. yds. at ~~20c~~ 10 | | 7,605.20 | 3802 — |
| *Main Wasteway—* | | | |
| 4,400 cub. yds. loose rock at ~~90c~~ 50 | $ 3,960.00 | | 2200 — |
| 4,400 cub. yds. solid rock at $2.25 ~~$1.~~ 1.00 | 9,900.00 | | 4400 — |
| 2,906 cub. yds. stone masonry at $12.00 ~~$7.~~ | 34,860.09 | | 20342 — |
| 192 cub. yds. concrete at $9.00 ~~$7.~~ | 1,728 00 | | 1344 — |
| Flume | 3,336.30 | | 2000 — |
| Planking floor below flume | 287.00 | | 200 — |
| | | | 310132 — |

| | | | |
|---|---|---|---|
| | Bank protection rock and fascine work | 500.00 | 54 971.30 |
| | Regulating bridge and weir | 400.00 | |
| | *Lower Tunnel* 865 ft. long— | | |
| | 1,994 cub. yds. excavation at ~~$7.00~~ | 13,958.00 | |
| | 498 cub yds. brick lining at 20 cts | 9,960.00 | |
| | 713 cub. yds. concrete outside of brick ~~$9~~ | 6,417.00 | |
| | 262 cub. yds. concrete around pipe at ~~$9~~ | 2,358.00 | |
| | Timber lining | 2,535.00 | 35,228.00 |
| | *Shaft* 160 *Feet Deep.* | | |
| | Excavation 295 cub. yds at $8. | $ 2,360 00 | |
| | Brick work, 70 cub. yds. @ $20. | $1.400 00 | |
| | Concrete 124 cub. yds. @ ~~$9~~ | 1,116.00 | |
| | Valve and hoisting gear | 200.00 | $5,076.00 |
| | *Inlet to Lower Tunnel.*— | | |
| | Masonry stone, 259 cub. yds. @ $12 | $3,108.00 | |
| | Cast iron rings on trunk and seat, 7 in. high, 49¾ in. inside diameter, 2,290 lbs, @ 6c | 137.40 | |
| | Bolts for same | 25.00 | |
| | Trunk 57 ft. high in sections | 702.00 | $3,972.40 |
| | *Wasteway Outlet to Lower Tunnel.*— | | |
| | Excavating 322 cub. yds. | $ 193.20 | |
| | Masonry lining 83 5-10 cub. yds. @ ~~$12~~ | 1,002.00 | |
| | Flume | 140.00 | |
| | Cement filling under floor | 220.00 | |

| | | | |
|---|---|---|---|
| Wall supporting end of flume 30x40x5,222 cub. yds @ $12. | 2,664.00 | $4,219.20 | |
| *Upper Tunnel* (410 feet long) | | | |
| Excavating 1,230 cub. yds. @ $7, | $8,610.00 | | |
| Excavation (new portion) 624 cub. yds | 4,368.00 | | |
| Timber lining 618 ft. @ $6.70 | 4,140.60 | | |
| 175 ft. relined with brick masonry, 118 cub. yds. @ $20.. | 2,360.00 | | |
| Concrete filling 122 cub. yds. @ $9 | 1,098.00 | $20,576.60 | |
| *Shaft to Upper Tunnel* (60 ft. deep 8.2 in. dis.) | | | |
| Excavation 175 cub. yds. @ $7, | $1,225.00 | | |
| Brick lining 41 cub. yds. @ $20 | 820.00 | | |
| Concrete filling 20 cub. yds. @ $9 | 180.00 | 2,225.00 | |
| Inlet tunnel 35 feet long @ $30, | $1,050.00 | 1,050.00 | |
| Headgate to upper tunnel, masonry in gate and walls, 756 yds. @ $14 | 10,584.00 | 10,584.00 | |
| *Wasteway and Chute to Upper Tunnel.* | | | |
| Excavations 444 cub. yds. | $ 222.00 | | |
| Timber lining and chute | 334.00 | | |
| Cement filling under floor, 55 cub. yds. @ $9 | 495.00 | 1,051.00 | |
| Screen tanks | Abandoned. | 3,800 | |
| Clearing 333 acres lake bed at $60 | | 19,980.00 | |
| Fencing 15 miles @ $600.00 | | 9,000.00 | |
| Roads and bridges 15 miles at $3,000 | | 45,000.00 | |
| Barges 3, at $300 | | 900.00 | |
| Five miles water ditch, flumes, hydraulic pipes, etc | | 7,500.00 | |
| Pumps and boiler for supply at stables and residences | | 1,800,00 | |

| | | |
|---|---|---|
| | 200.000 trees planted | 9,000.00 |
| 9324 | Walls covering face of permeable rock from wasteway to upper tunnel headgate, 340 ft in length, 40 to 50 ft high, 1,332 cub. yds. masonry at ~~$12~~ $8.7 | 15,984.00 |
| — — — | Refilling hole washed out at mouth of upper tunnel | 2,000.00 |
| — — — | Puddle wall and embankment washed out during construction 21,200 cub. yds | 31,800.00 |
| — — — — | Stocking lake with fish | 1,000.00 |
| | | $813,851.90 |

TEMESCAL RESERVOIR.

| | | |
|---|---|---|
| 1600 | Buildings past and present | $10,000.00 |
| — — — | Work on original dam abandoned | 14,000.00 |
| 4300 | Excavation for puddle wall, 10,761 cub. yds. builders gravel and soil @ ~~75c~~ .40 | 8,085.75 |
| 2700 | Earth stripped from surface underneath dam 9,295 cub. yds. @ ~~60c~~ .30 | 5,577.00 |
| 17000 | Puddle wall bottom 30 ft. bottom by 18 ft. on top, 33,990 cub. yds. @ $1.75 .50 | 59,482.50 |
| 113720 | Embankment 227,440 cub. yds. @ 70c .50 | 159,208.00 |
| — — — — | Brick tower 50 ft. high destroyed by land slide | 6,000.00 |
| 720 | Stone paving, 600x15, 9,000 superficial ft @ ~~10c~~ .8 | 900.00 |
| 1000 | Pipes through bank tunnel gates, &c., in use and abandoned | 6,000.00 |
| 500 | Stand pipe and strainer | 700.00 |
| 7700 | Waste way, 1106 cub. yds. masonry @ ~~$12~~ $13,272.00; Timber work $128.00 | 13,400.00 |
| 100 | Aerating tank, 33,000 (1883) | 1,500.00 |
| 900 | Grubbing lake bed, 18.5 acres @ ~~$80~~ .50 | 1,480.00 |
| 1200 | Fencing 2 miles | 1,280.00 |
| 2000 | Roads and bridges, 1.81 miles at $3,000 | 5,430.00 |
| — — — | Ditches and flumes, 5 miles at $2,000 | 10,000.00 |
| — — — — | 2,000 ft. 12-inch pipe | 2,000.00 |
| | | $305.043.25 |

2 inch pipe 18.5
Less than 2 in 155.410 feet 29-4 Miles } 47.9
Cast Iron 281.414 " 53-3 "
Wt Iron Riveted 397.058 " 57 ~~[illegible]~~ "
Average Cost per Mile Excluding small sizes $3200



## PIPE DISTRIBUTING SYSTEM.

| Diam. Inches. | Character. | Total Length Laid. | Total Cost per ft. | Weight per ft. lbs. | Total Cost. | |
|---|---|---|---|---|---|---|
| 0.50 | Glv. wrt | 85 | 20 | 0.5 | $ 17 00 | 4 25 |
| 0.75 | " " | 4,080 | 25 | 1.3 | 1,020 00 | 244 80 |
| 01. | " " | 44,088 | 30 | 1.75 | 13,226 40 | 3306 60 |
| 1.25 | " " | 41,321 | 40 | 2.75 | 16,528 40 | 3925 49 |
| 1.5 | " " | 65,836 | 50 | 3.67 | 32,918 00 | 7571 14 |
| 2 | " " | 97,491 | 64 | 3.67 | 62,394 24 | 11698 92 |
| 3 in. | cast | 44,646 | 1.06 | 15 | 47,324 76 | 11161 50 |
| 3 " | tubes | 17,030 | 1.00 | 8 | 17,030 00 | 3065 40 |
| 4 " | cast | 92,908 | 1.28 | 18.3 | 118,922 24 | 32517 80 |
| 5 " | sheet | 15,192 | 1.22 | 6.25 | 18,524 34 | 4557 60 |
| 5 " | cement | 98,687 | 1.35 | 5 | 131,716 45 | 29606 10 |
| 6 " | sheet | 4,490 | 1.26 | 7.5 | 5,657 40 | 1616 40 |
| 6 " | cast | 46,667 | 1.99 | 30.75 | 92,867 33 | 25666 88 |
| 7 " | sheet | 49,910 | 1.29 | 8.5 | 64,383 90 | 20962 20 |
| 7 " | cement | 60,632 | 1.58 | 6.75 | 95,798 56 | 25465 44 |
| 8 " | cast | 18,609 | 2.60 | 45.5 | 48,383 40 | 14142 84 |
| 9 " | sheet | 7,915 | 1.72 | 10.75 | 13,613 80 | 4353 25 |
| 10 " | cast | 2,600 | 3.40 | 53.33 | 8,840 00 | 2600 00 |
| 11 " | sheet | 12,737 | 2.04 | 13 | 25,983 48 | 8406 42 |
| 12 " | cast | 5,984 | 4.40 | 70.75 | 26,329 60 | 7898 88 |
| 13 " | sheet | 7,085 | 2.43 | 15 | 17,216 55 | 5626 30 |
| 15 " | cement | 39,253 | 4.15 | 23 | 162,899 95 | 35327 70 |
| 22 " | wr't | 2,660 | 7.15 | 35.75 | 19,019 00 | 3591 00 |
| 24 " | wr't | 38,420 | 8.52 | .... | 327,511 00 | 67235 00 |
| 24 " | taken up reld | 5,652 | 3.31 | .... | 18,708 12 | 2826 00 |
| 48 " | steel 5 1-6 | 340 | 25.76 | 210 | 8,758 40 | 1020 00 |
| 48 | wr't | 32 | 14.61 | 158 | 467 50 | 80 00 |
| 37.5 | wr't laid | 25,314 | .... | 77 | 199,014 15 | 75942 00 |
| 37.5 | wr't unlaid | 1,318 | 5.00 | 77 | 6,590 00 | 2636 00 |
| | | 835,882 | | | $1,601,667.87 | 412955 88 |

Total length of pipe laid.....157 miles
Average cost per mile (all sizes).....$10,201.70
Total length of pipe in use.....152.2 miles

Original Est $ 1.601 667-87
Reproduction 1897 412 955-88
difference $ 1.188.711.99

Included in general System of no Value in this Estimate



PIPE TAKEN UP.

| | | | | | |
|---|---|---|---|---|---|
| ¾ in. galv. | 225 ft | @ 15c | for removal.. | $ | 33 75 |
| 1 " " | 6,258 " | 15c | " " .. | | 938 70 |
| 1¼ " " | 6,078 " | 15c | " " .. | | 911 70 |
| 1½ " " | 6,606 " | 15c | " " .. | | 990 75 |
| 2 " " | 11,932 " | 15c | " " .. | | 1,789 80 |
| 3 " cast | 56 " | 25c | " " .. | | 14 00 |
| 3 & 3¼ in. tubes | 312 " | 20c | " " .. | | 62 40 |
| 4 in. cast | 360 " | 30c | " " .. | | 108 00 |
| 5 " sheet | 1,250 " | 30c | " " .. | | 375 00 |
| 5 " cement | 11,521 " | 30c | " " .. | | 3,456 30 |
| 6 " cast | 200 " | 40c | " " .. | | 80 00 |
| 7 " sheet | 1,250 " | 40c | " " .. | | 500 00 |
| 7 " cement | 24,405 " | 40c | " " .. | | 9,760 00 |
| 9 " wrought | 5,335 " | 50c | " " .. | | 1,667 50 |
| 11 " " | 860 " | 60c | " " .. | | 516 00 |
| 13 " " | 330 " | 65c | " " .. | | 344 50 |
| 24 " taken up and not relaid (1895) | | | " .. | | 9,300 00 |
| Total removed, 75,178 ft. | | | Total cost.. | | $30,843 40 |

PIPE TAKEN UP AND CONDEMNED.

of no Value

| | |
|---|---|
| 1 in. galvanized | 5,348 ft |
| 1¼ " | 5,225 ft |
| 1½ " | 3,709 ft |
| 2 " | 2,000 ft |
| 3 and 3¼ tubes | 312 ft |
| 5 in. sheet | 1,250 ft |
| 5 " cement | 6,231 ft |
| 7 " sheet | 1,250 ft |
| 7 " cement lined | 18,210 ft |
| 11 " wrought | 860 ft |
| 13 in. " | 530 ft |
| Total Condemned | 44,920 ft |

Not included



PIPE TAKEN UP AND RELAID.

| | |
|---|---|
| 1 in. galvanized | 915 ft |
| 1¼ in. " | 853 ft |
| 1½ in. " | 2,897 ft |
| 2 in. " | 9,932 ft |
| 3 in. cast | 56 ft |
| 5 in. cement lined | 5,290 ft |
| 6 in. cast | 200 ft |
| 7 in. cement lined | 6,195 ft |
| 9 in. wrought | 3,335 ft |
| Total pipe taken up and relaid | 29,673 ft |

SERVICE COCKS AND GATES.

| Diam. | Number. | | Cost. | |
|---|---|---|---|---|
| 1 in. | 67 | 60 | $ 152 76 | 40 - |
| 1¼ in. | 77 | 75 | 252 72 | 58 - |
| 1½ in. | 179 | 100 | 794 76 | 179 - |
| 2 in. | 196 | 150 | 1,378 08 | 294 - |
| 3 in. | 70 | 70 | 2,772 00 | 490 |
| 4 in. | 333 | 10 - | 15,583 40 | 3330 |
| 6 in. | 213 | 15 - | 13,035 60 | 3195 |
| 8 in. | 21 | 25 - | 1,587 60 | 525 |
| 10 in. | 8 | 30 - | 960 00 | 240 |
| 12 in. | 10 | 40 - | 1,644 00 | 400 |
| 14 in. | 37 | 60 - | 7,735 00 | 2220 |
| 22 in. | 7 | 150 - | 3,544 80 | 1050 |
| 24 in. | 10 | 200 - | 6,288 00 | 2000 |
| 48 in. | 1 | 800 - | 1,000 00 | 800 |
| | | | $56,718 72 | 14821 |

TEES.

| Diam. | Number. | Cost. |
|---|---|---|
| 5 in | 10 | $ 44 70 |
| 4 in | 137 | 1,061 75 |
| 6 in | 95 | 973 50 |
| 8 in | 46 | 780 00 |
| 10 in | 12 | 312 00 |
| 12 in | 16 | 532 00 |
| 14 in | 53 | 2,146 50 |
| 16 in | 1 | 47 70 |
| 22 in | 2 | 100 00 |
| 24 in | 11 | 825 00 |
| 37½ in | 1 | 150 00 |
| | Say $ 5 675 | $6 973 20 |

CROSSES.

| Diam. | Number. | Cost. |
|---|---|---|
| 3 in | 24 | $ 121 20 |
| 4 in | 239 | 1,912 00 |
| 6 in | 88 | 1,254 00 |
| 8 in | 27 | 540 00 |
| 10 in | 9 | 290 00 |
| 12 in | 6 | 249 00 |
| 14 in | 94 | 4,798 70 |
| 22 in | 12 | 600 00 |
| 24 in | .. | 75 00 |
| 37½ in | 1 | 200 00 |
| | Say $10.000 | $10,039 90 |

COST OF LAYING 24-IN. MAIN, 1875—38,420 FEET.

2,500 ft. No. 12 at 35½ lbs... 88,750 lbs.
2,500 ft. No. 11 at 39 lbs.... 97,500 lbs.

| | | |
|---|---|---|
| 10,000 ft. No. 10 at 43½ lbs.. | 435,000 lbs. | |
| 23,420 ft. No. 9 at 48 lbs.... | 1,184,160 lbs. | |
| Total weight..... | 1,805,410 at 6 cts., | $108,324 |
| Manufacturing by hand labor at $3.50 per ft... | | $134,470 |
| Dipping in asphaltum 38,420 ft. at 24 cts. per ft. | | 9,220 |
| Hauling and distributing at $6.00 per ton..... | | 5,700 |
| Mechanical work in trench—38,420 ft. at 80c.. | | 30,736 |
| *Digging and refilling*— | | |
| Rock—exc. 19,620 cub. yds. at $1 ..... | $19,620 | |
| Earth—exc. 28,700 cub. yds. at .60..... | 17,220 | |
| Joint holes—1,480 at $1.50 each..... | 2,220—39,060 | |
| Total ..... | | $327,510 |

COST OF 37½ IN. MAIN LAID IN 1885.

LENGTH 25,314 FEET.

| | |
|---|---|
| Cost of iron freight, insurance, hauling, storage, drayage, weighing, inspecting and delivery to shop..... | $65,616.40 |
| Cost of manufacturing and laying as per contract, 25,314 feet at $2.875..... | 72,777.75 |
| Cost of excavating trench, 51,200 cub. yards at 60c..... | 30,720.00 |
| Cost of excavating joint holes..... | 1,800.00 |
| Cost of refilling and tamping, including 7,500 cub. yds. sand..... | 15,000.00 |
| Cost of manholes, blow-offs, air valves, &c. | 7,000.00 |
| Cost of bridges, culverts and waterways... | 2,500.00 |
| Cost of telephone line..... | 2,000.00 |
| Cost of rights of way..... | 1,400.00 |
| | $199,014.15 |

COST OF 37½ IN. MAIN UNLAID.

LENGTH 1,318 FEET,

| | | | |
|---|---|---|---|
| Iron plates at | $2.60 | per foot..... | |
| Manufacturing | 2.32.5 | " " ..... | |
| Pitting and covering | 7.5 | " " ..... | |
| Total..... | $5 | " " ..... | |
| 1,318 feet at $5 per foot..... ..... | | | 6,590.00 |
| Total cost of 37½ in pipe..... | | | $205,604.15 |

3

# AN ACT

TO

# AUTHORIZE THE CITY OF OAKLAND

TO

# Obtain a Supply of Water.

9005

AN ACT

# TO AUTHORIZE THE CITY OF OAKLAND

## TO OBTAIN A SUPPLY OF WATER.

*The People of the State of California, represented in Senate and Assembly, do enact as follows:*

SECTION 1. The City of Oakland may exercise the right of eminent domain, by taking for public use, in order to supply said City and adjacent towns, and the people therein with water, any flowing stream or streams of water, lake or lakes, or artificial reservoir or reservoirs, or places for the construction of the same within the County of Alameda, and the land over which the stream or streams flow, or which the lake or lakes cover, and all riparian rights connected therewith, and sufficient land to build dams, and for reservoirs to hold such water, and the right of way to lay pipes to conduct such water, and any water-works now or hereafter conducting water to said city, with the water pipes, reservoirs, rights to water, rights of way for pipes and lands, and appurtenances of every kind connected with or belonging to such water-works, or the person or persons, corporation or corporations owning or claiming the same.

SEC. 2. A Board of Public Works is hereby created to be called the Board of Public Works of Oakland, consisting of five persons, who shall be citizens of Oakland, and who shall be appointed by the Governor of the State for the

term of four years. They shall receive no compensation for their services. Said Board shall meet on the third Tuesday, [19th] of May, eighteen hundred and seventy-four, and at such other times as they may appoint. A journal of their proceedings shall be kept. They shall appoint one of their number President, and one to act as Secretary, in the absence of the City Clerk or his Assistant. They shall provide for calling special meetings. A majority of the Board shall constitute a quorum. They shall adopt rules for their proceedings, and have power to fill vacancies occurring in their body. Their meetings shall be public. On all questions requiring the concurrent action of the City Council, or the delegation of authority, the vote shall be by yeas and nays, and be recorded in the journal of their proceedings; and a majority of all the members shall be necessary to carry any proposition on which they may vote, except a motion to adjourn, which may be carried by a majority of the members present. Before entering upon their duties they shall each take and subscribe to the oath of office as members of the Board.

Sec. 3. The City Council of Oakland, and the Board of Public Works shall have authority to do all things consistent with law, and recited in this Act, and relating to preliminary examinations with reference to obtaining a supply of water for the City of Oakland and the Towns of San Leandro, Alameda, and adjacent neighborhoods, and the terms of purchase of water rights or works, and condemnation of the same, and the employment of counsel and engineers, and the letting of contracts, and the issuing of bonds, and the sale thereof, and the construction of works, and maintaining of the same, and the expenditure of money, and the incurring of any debt or obligation of indebtedness in obtaining said

supply of water, and in the appointment of agents or commissioners to represent the city in any work or duty connected with the work aforesaid, and defining their duties ; but neither the City Council nor the Board of Public Works shall have any authority as aforesaid, unless by the separate and concurrent action of both bodies.

Sec. 4. At any time when the City Council and the Board of Public Works may deem it expedient, three commissioners shall be appointed—one by the City Council, and two by said Board—who shall have power under instruction from said bodies, to act for and represent the City in all matters and proceedings necessary and incident to the procuring of a supply of water for the City, by purchase, or condemnation, or otherwise, as provided in section one of this Act; and the grant, or purchase, or acquisition of any rights or property obtained under this Act, shall be made to and for the City. Said Commissioners shall give bonds payable to the City and to be approved by the Council, for the faithful performance of their duties, in such amounts as the City Council and the Board of Public Works may require, and shall receive such compensation as the Council and the Board may fix.

Sec. 5. In all matters relating to the condemnation of lands and water rights, and rights of way, and obtaining and supplying the City of Oakland and adjacent towns with water as set forth in this Act, and where the Board of Public Works has no concurrent power with the City Council, the Council shall have full authority to do all things consistent herewith, and necessary to carry into effect the provisions of this Act.

Sec. 6. Before proceeding to condemn any property mentioned in section one of this Act, said Board shall endea-

vor to purchase the same from the owner or owners, and if the parties cannot agree on the terms of sale and purchase, said Board may proceed to condemn the same.

Sec. 7. On condemning said property, the proceedings must be taken under title seven, part three, of the Code of Civil Procedure, and all the sections of said title are made applicable to and a part of this Act, and in such proceedings, the said Board of Public Works shall be the plaintiff.

Sec. 8. For the purpose of paying for any lands or property required to be purchased, or condemned under the provisions of this Act, and for the purpose of carrying out any of the provisions of this Act, the Board of Public Works shall have power to issue bonds of the City of Oakland, payable on the first day of July, A. D. eighteen hundred and ninety-six, unless previously redeemed, as is herein provided, to an amonnt not exceeding eight hundred thousand dollars; said bonds shall be of denominations not less than five hundred dollars, and shall have coupons attached for the interest thereon, which interest shall be at the rate of seven per cent. per annum, payable semi-annually, on the second day of January and the first day of July, of each year, and said principal and interest shall be made payable at the office of the Treasurer of the said City of Oakland. Said bonds shall be signed by the Mayor and the Treasurer of said City, and countersigned by the President of the Board of Public Works, and the coupons shall be signed by said Treasurer, and said bonds shall be numbered consecutively from one to the last number issued. For the purpose of liquidating the bonds issued as aforesaid, the City Council of Oakland is hereby authorized to levy annually a special tax from and after the year eighteen hundred and eighty-six, in sufficient amounts to redeem ten per cent. annually of the outstand-

ing bonds, (the redemption of which may not otherwise have been provided for) and until all of said bonds shall have been redeemed, and the money arising from said tax shall be used for no other purpose than the redemption of said bonds.

Sec. 9. Whenever said Board of Public Works require money to pay for said property, whether obtained by purchase or condemnation, they may sell said bonds to obtain said money, or they may make payment for said property in said bonds, at the par value thereof, if they can make a contract to that effect, and think it for the pecuniary interest of said City to do so.

Sec. 10. The money thus obtained shall be kept by the City Treasurer, subject to the order of said Board, and shall be used for no other purpose than to pay for said property, and the costs of legal proceedings, and to construct the necessary works to bring the water into said City, and distribute the same, and the purchase of materials therefor, and all expenses connected therewith, and the interest on said bonds until the receipts from the sale of water will pay said interest, and the money obtained by the sale of water from the water-works, shall be called the "Water Work's Fund."

Sec. 11. The money received from the sale of water from said Water Works, shall be kept by the City Treasurer, subject to the order of said Board of Public Works, and shall be used for no other purpose than to pay the expenes of the care and management of and repairs to said water-works, and the interest on and redemption of said bonds, until the same are all paid.

Sec. 12. Whenever there is in said "Water Work's Fund" not less than fifteen thousand dollars, not required for the care and management of and repairs to said water-

# CATALOGUE

OF

# REFERENCES,

CONCERNING

## VARIOUS MODES OF ASSESSING PROPERTY

FOR

# WATER RATES.

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*Gathered from the Official Reports of Cities and Towns in the United States.*

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OAKLAND, CAL.,
1880.

# CATALOGUE OF REFERENCES.

The charges for Fire Hydrants in the following list are *per annum*. The words "per annum" were omitted in some places for brevity.

## ALABAMA.

**MONTGOMERY, Private.**

Letter of January 6, 1880.

Charge $100.00 for each fire hydrant, and give no free water.

## CONNECTICUT.

**ANZONIA, Private.**

Letter of January 9, 1880.

Charge $30.00 for each fire hydrant.

**BINGHAMTON, Private.**

Letter of Jan. 5, 1880.

Charge $30.00 for each fire hydrant, and give no free water.

**DANBURY, Public.**

Report of 1875.

Acts, Charters and By-Laws.

**HARTFORD, Public.**

Leter dated Jan. 5, 1880.

Charge $30.00 for each fire hydrant.

Report of 1875, pages 26 and 27,

Pays $8,280.00 for water for fire hydrants.

" $1,694.00 " sprinkling.

Report of 1876 page 33,

**HARTFORD, Continued.**

Bonded debt, $1,052,000.00.

Report of 1878, pages 11, 12 and 13,

Remarks on the justice of charging for all water used for city purposes.

Report of 1879, page 19,

Table of family water rates in various cities.

**NEW BRITAIN, Public.**

Report of 1874.

Acts, Charters, page 10, justice of charging the city for water.

## COLORADO.

**DENVER, Private.**

Letter of Jan. 12, 1880.

All property along line of pipe is equally benefited whether using it or not.

## DELAWARE.

**NEW CASTLE, Private.**

Letter of Jan. 6, 1880.

The city pays for all water used except for that furnished 25 fire hydrants.

**WILMINGTON, Public.**

Letter of Jan. 5, 1880.

Buildings not using water pay a protection tax.

Report of 1878,

Page 57, remarks on impurities in water.

" 74, " " " " "

## GEORGIA.

**AUGUSTA, Public.**

Letter dated Jan. 9, 1880.

Every unimproved lot in front of which water pipes are laid, pays water rates.

# ILLINOIS.

**ALTON, Private.**

Letter of Jan. 3, 1880.

Receive $100.00 per annum for fire hydrants; think laws of Cal. should be altered to suit the times, so that all property along pipe should pay.

**CHICAGO, Public.**

Report of 1878,

Pages 95 to 101, impurities in water.

**HYDE PARK, Public.**

Revised Ordinanees, 1876.

Laws, Ordinances, Charter and general law.

Page 100, Rules and Regulations.

" 108, family water rates.

" 109, metered " "

" 170, levy and collect water tax, assessment, etc.

" 189 and 190, power to provide water and tax for it.

" 192, cities may contract for water supply, levy and collect tax on property, etc.

**ROCK ISLAND, Public.**

Report of 1877.

Page 5, 78 hydrants pay $75.00 each.

" 15, bad water from wells.

" 16, animalculæ not bad, but purify water.

" 18, sewer matter dangerous.

" 19, test of water.

# INDIANA.

**INDIANAPOLIS, Private.**

Report of 1873

Page 11, Water Co. to be allowed 10 per cent. per annum, profit on their investment.

Page 12, property benefited along line of water pipe.

" 15, city pay for fire protection, $12,162.51.

**INDIANAPOLIS, Continued.**

Page 21, 181 fire hydrants pay $50.00 each.
" 31, analysis of water.
" 35, general laws.
" 36, the city could be a stock-holder.
" 37, give power to charge cities and inhabitants for water.
" 39, city to pay for water.
" 43, water rates.

**TERRE HAUTE, Private.**

Letter dated Jan. 3, 1880.

There ought to be a charge for fire protection. Laws under which charter was granted.

## IOWA.

**ANAMOSA, Private.**

Letter dated Jan. 3, 1880.

Ordinance, articles of incorporation.

If the same laws were in force in Iowa you have in Cal. there would be no water works constructed here. Charge for water to sprinkle and for fire purposes.

**CEDAR RAPIDS, Private.**

Letter and rates dated Jan. 2, 1880.

City allowed to levy a tax of five mills on the dollar of the assessed value of the property within the protection limit. See page 11.

**DEVENPORT, Private.**

Letter and rates dated Jan, 3, 1880.

Page 4, charge $80.00 per annum for each hydrant.

**LYONS.**

Letter dated Jan. 7, 1880.

Are allowed to collect a tax of five mills on all property within the fire limits.

**MUSCATINE, Private.**

City Ordinance.

Page 3, city to pay $75.00 per hydrant.

" 5, grant right to build reservoir on public square.

## KENTUCKY.

**LOUISVILLE, Private.**

Report of 1876.

Page 8, city pays $32,806.00 for water for public use.

" 7, city subscribed $1,270,000.00 towards stock of company.

## MAINE.

**BANGOR, Public.**

Report of 1878.

Page 8, table of prices in various cities for water measured per 1000 gallons.

Charter and Ordinances, pages 170 and 171.

City allowed to pay a total of $12,000.00 for water furnished public departments. Fire hydrants each, $50,00 per annum.

**ROCKLAND, Private.**

Letter dated Jan. 14, 1880.

Company is exempt from taxation for furnishing public water.

## MICHIGAN.

**ALLEGAN, Public.**

Letter dated Jan. 10, 1880.

All property assessed for interest on water bonds.

**BAY CITY.**

Fire hydrant pays $50.00 for each hydrant.

Pages 5 and 6, Laws, Ordinances, Acts,

**DETROIT, Public.**

Report of 1873, page 12.

Vaeant lots in front of which water pipe are laid, to pay three eents per lineal foot.

Report of 1875.

Pages 48 and 55, assessment of property.

Aets of ineorporation, Aets, Ordinanees and By-Laws.

**KALAMAZOO, Public.**

Rates dated May 5, 1879.

Metered water as high as in Cal.

Sprinkling eharged for.

**PORT HURON.**

Letter Jan. 8, 1880.

Charge three cents per lineal foot front on property before whieh water pipe is laid.

## MINNESOTA.

**MINNEAPOLIS, Public.**

An Ordinanee, page 5, pay for sprinkling.

## MISSOURI.

**KANSAS CITY, Private.**

Sprinkling costs per square per month, $10.00.

## MARYLAND.

**ANNAPOLIS, Private.**

Letter of Dec. 24, 1879.

City pays precisely as private individuals. None of the prviate Companies in the State of Maryland are obliged to furnish free water for any purpose.

# MASSACHUSETTS.

**BROOKLINE, Public.**

Report of 1879.

Page 9, from highway department for sprinkling streets $2,030.00.

" 9, Fire Department, $3,700.00.

**DANVERS,**

Report of 1878.

Page 4, find that 70 cities pay an average of $62.34 per hydrant.

" 41, propriety of charging towns for public water will be admitted to be just and proper when duly considered.

**GREENFIELD, Private.**

Letter dated Jan. 22, 1880.

There is a general law that permits all water Companies to contract with the city or town. We have six works in as many different States, and the contracts are made under a similar law.

**HOLYOKE, Public.**

Report of 1876.

Pages 16 to 26, examination of bad and good water.

" 9 to 14, troubles with bad water.

**LAWRENCE, Public.**

Letter dated Jan. 13, 1880.

City allows $10,000.00 for public water, each year.

Report of 1878.

Page 17, city is charged with all public water from the several departments.

**LOWELL, Public.**

Report of 1879.

Page 69, 653 hydrants pays at $20.00 ; $12,948.33.

**BINGHAMTON, Public.**

Letter dated Jan 10, 1880.

Wherever main pipes are laid charge 50c. for every 25 feet front.

**CORNING, Private.**

Letter dated Jan. 9, 1880.

City pays interest on $25.000 for public water.

**ELLENVILLE, Public.**

Letter of Jan. 10, 1880.

Portion of receipts collected for public water by general tax.

**MIDDLETOWN, Public.**

Letter of Jan. 12, 1880.

Says all the towns and villages in that neighborhood pay for all public water.

**NEWBURGH, Public.**

Letter dated Jan. 12, 1880.

The burden of maintaining hydrants and furnishing protection to all at the expense of a few, is a sore and an old grievance.

**PEEKSKILL, Public.**

Report of 1877.

Acts and Ordinances.

**ROCHESTER, Public.**

Report of 1875.

Page 12, advantage of water works.

" 13, saving in insurance.

" 14, posterity is to pay principal, and with vastly more ability to pay.

Report of 1879.

Page 22, each pub. department should pay.

" 23, water smells bad.

" 26, pressure regulator.

Laws, Ordinances, relating to the construction of the Rochester water works, various acts also relating thereto.

**SARATOGA, Private.**

Letter of Jan. 9, 1880.

We tax non-consumers where the mains are laid before their premises and all within 300 feet of a fire hydrant.

Laws, Acts and By-Laws.

**SYRACUSE, Private.**

Letter dated Jan. 9, 1880.

City pay for water for all public purposes, except fire purposes, and for this receive $25,000—now want $40,000.

**TROY, Public.**

Report of 1876.

Charge two cents per running foot for vacant lots.

**WARSAW, Private.**

The village pay water works for water for fire purposes.

**YONKERS.**

Acts, Ordinances and By-Laws.

## NEW HAMPSHIRE.

**CONCORD, Public.**

Report of 1878. Page 4.

Great saving from loss by fire.

**MANCHESTER, Public.**

Report of 1873.

Page 19. Danger of well water.

" 40. Pays $60 for each fire hydrant per year.

" 41. Report on Iron Cement Pipe.

Report of 1874.

Page 42. Street sprinkling $1 per 1000 square feet.

" 43. Meter rates.

## NEW JERSEY.

**MORRISTOWN, Private.**

Letter of January 9, 1880.

Suit brought by Water Company to prevent city having use of hydrants free. The Water Company came out ahead.

**PATERSON, Private.**

Letter of Jan. 10, 1880.

Charge city $37 per hydrant.

Report of Passaic of 1879.

Vacant lots along pipe lines pay 10 cts per 100 square feet lying within 100 feet of pipe line.

**TRENTON, Public.**

Report of 1867.

Laws, Ordinances, By-Laws, &c.

## NEVADA.

**EUREKA, Private.**

Letter of Jan. 3, 1880.

Have made a contract with the town by which they are compensated for all water used, including fire purposes.

## OHIO.

**CINCINNATI, Public.**

Report of 1875.

Page 114. General Laws, Acts, Ordinance.

Report of 1876.

Pages 75 to 94. Ordinances and Acts in full.

" 96. Street sprinkling 20 cts per lineal foot per season.

**CLEVELAND, Public.**

Report of 1877.

Page 8. Cost of works $2,402,354.43; revenue, $152,-794.68.

Page 9. Bonded debts, $1,725,000.

" 10. Tax on real and personal property to pay interest.

Page 19. Water rents various cities.

**MIDDLETOWN, Public.**

Report of 1875.

Statute Laws of Ohio, Acts, Ordinances.

**SANDUSKY, Public.**

Letter of Jan. 10, 1880.

Private companies in Ohio charge for water for fire and other public purposes.

Report of 1876.

Page 7. Protection from fire and reduces insurance.

" 44, 45, 46. " " " "

" 52. State Law and Acts.

" 64. Street sprinkling carts, per square for the season, $6.

**TOLEDO, Public.**

Letter Jan. 8, 1880.

We tax property so much per lineal foot.

Laws, Acts, Ordinances, Rules, &c.

Report of 1877.

Page 25. Bad smell to water. Filteration.

" 27. Bad quality of well water.

**YONKERS.**

Laws, Acts, Ordinances in full.

**ZANESVILLE, Public.**

Report of 1879.

Acts, Ordinances, By-Laws and Regulations.

Letter Jan. 10, 1880.

Pointing out the injustice of supplying public water free. (Very interesting remarks.)

## PENNSYLVANIA.

**ALTOONA, Private.**

Letter dated January 8, 1880.

Non-consumers pay half minimum rates.

**CARBONDALE, Private.**

Report of 1869.

Charter, By-Laws.

Page 11. Fire Hydrants, $25 each.

**CONSHOHOCKEN, Private.**

Letter dated Jan. 7, 1880.

Allowed to collect a protection tax; also, get pay for fire hydrants.

**HARRISBURG, Private.**

All buildings in front of which water pipes are laid shall pay a protection tax of $2.

**MEDIA, Public.**

Letter, Jan. 9, 1880.

Assess property in front of which water pipe is laid; also, charge protection tax and for all other public water.

**OIL CITY.**

Letter, Jan. 9, 1880.

Private water companies in this state have power to contract with the city authorities for any amount they may agree upon for public water.

**PITTSBURGH, Private.**

Rates for 1875.

One-third of full water rates charged to non-consumers along line of pipe and buildings within 1000 feet of fire hydrant, one-sixth of full rates.

**TOWANDA, Private.**

Letter of Jan. 9, 1880.

Borough to pay $50 for each hydrant.

**TIOGA, Private.**

Letter of Jan., 1880.

Collect $25 per hydrant.

**WILKES-BARRE.**

Letter of Jan. 14, 1880.

The city paid water company $45,500 for the perpetual use of 50 hydrants.

# RHODE ISLAND.

**BRISTOL, Public.**

Letter dated Jan. 16, 1880.

No corporations in Rhode Island are required to furnish free water for public purposes.

**PROVIDENCE, Public.**

Report of 1879.

Pays $30 each for 1103 hydrants.

Sprinkling carts (2 horse) per week, $12.
" " (1 horse) " $6.

# TEXAS.

**AUSTIN, Private.**

City pays $80 for each hydrant.

**SAN ANTONIO, Private.**

Letter of Jan. 7, 1880.

The laws of this state do not compel water works companies to furnish any public water free. Get $100 for each hydrant.

# VERMONT.

**BURLINGTON, Public.**

Report of 1877.

Page 18. Water Rates.
" 19. Fire Department pays $1,285.
" 21. About good hydrants.
" 22. Good advice to select public officers.

This report contains many good suggestions.

**HYDE PARK, Private.**

Letter dated Jan. 8, 1880.

Collect pay for every purpose, public or private.

**MONTPELIER, Private.**

Report of 1873.

Page 18. Water furnished by water companies always purer than the average well water.
" 19. The greatest advantage a city or town can have is an abundant supply of good water.

# VIRGINIA.

## LYNCHBURG, Public.

From Schedule of Rates.

The water tax upon property to which water is not supplied, situated upon streets along which water mains are laid, shall be one-fourth of 1 per centum of its assessed value.

## NORFOLK, Public.

Report of 1878.

Page 12. Fire Department, Street Department and Board of Health should all be charged with their proportion of water.

" 35. Rates.

# WEST VIRGINIA.

## WHEELING, Public.

Report of 1878.

To pay interest on loan they tax all property along line of water pipe.

Acts, Ordinances and By-Laws.

# WISCONSIN.

## MILWAUKEE, Public.

Letter of Jan. 7, 1880.

All public buildings, parks and fountains are assessed on the same basis as private property. Street sprinkling is paid for by charging each cart, while in use, $40 per month, and water used for extinguishing fires, &c., is covered by a charge of $20 per annum per hydrant.

Report of 1876.

Pages 67 and 68. Extract from the City Charter showing the law for the collection of water rents.

620.1

Hon. J. M. Days

# REPORT

TO THE

# Lake Tahoe and San Francisco

## WATER WORKS COMPANY,

ON ITS

SOURCES OF SUPPLY; PROPOSED LINE OF WORKS; ESTIMATED COST AND INCOME.

BY

A. W. VON SCHMIDT,

CIVIL ENGINEER;

PROJECTING AND CONSTRUCTING ENGINEER OF THE SAN FRANCISCO WATER WORKS, SPRING VALLEY WATER WORKS, WHITE PINE WATER WORKS, SAN FRANCISCO STONE DRY DOCK; INVENTOR AND PATENTEE OF THE NEW AND IMPROVED METHOD OF REMOVING SUBMARINE ROCKS, AS SUCCESSFULLY ACCOMPLISHED BY HIM IN THE REMOVAL OF BLOSSOM ROCK FROM THE HARBOR OF SAN FRANCISCO.

OCTOBER 1, 1871.

SAN FRANCISCO:

ALTA CALIFORNIA PRINTING HOUSE,

529 CALIFORNIA STREET,

1871.

# REPORT

TO THE

# Lake Tahoe and San Francisco

## WATER WORKS COMPANY,

*Compliments of*

A. W. Von Schmidt,

Chief Engineer

Lake Tahoe & San Francisco Water Works,

CALIFORNIA.

HIM IN THE REMOVAL OF BLOSSOM ROCK FROM
THE HARBOR OF SAN FRANCISCO.

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# REPORT.

San Francisco, Cal., October 1st, 1871.

*To the President and Board of Directors of the Lake Tahoe and San Francisco Water Works.*

Gentlemen:—At your request I herewith submit to you a Report on the water supply of Lake Tahoe, the proposed lines of your Company's works for the supply of mines, towns and cities, together with estimated cost and sources of income, as follows:

## SOURCES OF SUPPLY.

**Lake Tahoe,** the main source of supply of the Lake Tahoe and San Francisco Water Works, is located in the Sierra Nevada Mountains, at an elevation of 6,220 feet above the level of the sea, and covers an area of two hundred and forty square miles. Its greatest depth is 1.500 feet.

The quality of the water is probably the purest of any in the world, being produced from melting snows and mountain streams. The surrounding mountains are mostly of granite formation.

The only outlet of the Lake is the Truckee River, which flows during the dryest time of the year, in ordinary seasons, 800,000,000 gallons of water per diem, and for some months, during the floods, more than three times that quantity.

To guard against dry seasons, a Dam has been constructed by the Company, on the Truckee River at the outlet of the Lake, with suitable gates, for the purpose of storing the water, by preventing the floods from escaping out of the Lake and running to waste, at the same time allowing the necessary amount of water to flow down the Truckee River for the use of mills and manufactories. The Lake will fill to the capacity of this Dam in one ordinary season.

The quantity of water thus stored will be immense, and will be better understood by stating that one foot of water drawn from this Lake in a year, will give one hundred and thirty-seven million gallons per day.

The Lake will be raised by said Dam six feet above low water mark or about one foot above high water mark, it will then give six times 137,000,000 gallons, or 822,000,000 gallons per diem, without interfering with the natural or ordinary flow of the Truckee River, that is after the Lake is once filled to the height of the Dam.

A second Dam has been constructed on the Truckee River, at a point three and three-quarter miles below the Dam at the Lake, at which second Dam the water is diverted from the river and taken into a Canal.

Independent of the Lake, there are several creeks or streams which the Company can draw water from during the rainy season, and while the snow is melting in the Spring of the year, namely: Bear Creek, Squaw Valley Creek, Deer Creek and Hardscramble Creek, all of these streams are on the east side of the mountains, and are tributaries of the Truckee River below the Lake.

On the west side of the Sierras, the Company has several tributaries of the American river, which afford quite a large supply of water in the Spring and early Summer months. It will therefore be understood that water from Lake Tahoe will only be drawn, when these streams fail to supply the amount of water required; it is estimated that the Company will only require to draw from Lake Tahoe, about eight months out of the twelve.

## TITLE.

The Company's title and ownership to the waters and right of way is acquired and confirmed under and by virtue of the Incorporation Laws of the State of California, and by an Act of Congress of the United States, passed July 26th, 1866, entitled "An Act granting the right of way to Ditch and Canal owners, over the Public Lands, and for other purposes."

The right of way over the lands of the Central Pacific Railroad Company is not yet complete, owing to the fact of the final location of the Water Company's line of works not having been surveyed throughout the entire route.

A Franchise has been granted to the Company by the Board of

Supervisors of the City and County of San Francisco to lay pipes in the said City and County of San Francisco.

Similar rights to lay pipes can be obtained in other towns and cities en route, in the event that the Company does not contract for their supply directly with the authorities of such cities and towns.

## LINE OF WORKS.

To make the waters of Lake Tahoe available, the following work is necessary to be done:

The water from the Dam at the outlet of the Lake will flow down the Truckee River, three and three-quarter miles to the Company's second Dam on the river, at which point it is diverted from the river into a canal to be constructed, six miles long, through which it flows to the entrance of the proposed Tunnel at Hardscramble Creek, through the Sierra Nevada Mountains. The Tunnel by this Hardscramble Creek route is 26,400 feet, or five miles long. The water from the said canal enters and flows through this Tunnel coming out on the west side of the mountains at a point a short distance above the Soda Springs (so called) on the South Fork of the North Fork of the American River.

Several other routes for a Tunnel have been surveyed, that at the head of Cold Stream, surveyed for Railroad Tunnel, is 24,172 feet long, with an open cut half a mile long of an average depth of twenty feet; to reach the entrance of this Railroad Tunnel it would require nine miles more canal on the east side of the mountains, making fifteen miles of canal from said second Dam to entrance of Tunnel or cut. I am therefore of opinion that the Hardscramble route, although longer than some of the other lines, is by far the most preferable; so far as can be seen and judged of from the surface of the ground, the Hardscramble route is apparently free from Granite, the rock appears to be a volcanic stone, called by some "Cement Rock," it works and stands well.

The lines of the Company's works from the Tunnel will be as follows:

For mining purposes on the Main Ridge lying between the North and Middle Forks of the American River, the water is taken from the Tunnel and conveyed in a large Ditch say (for 500,000,000 gallons of water) fifteen feet wide at the bottom, twenty-seven feet wide at the top, and six feet deep, net water line, on a grade of ten feet to the mile where the lay of the ground

will permit such a grade, along the backbone of said Ridge to the several mining camps thereon, viz: Iowa Hill, Michigan Bluffs, Yankee Jims, Forest Hill and other places in that vicinity. It is estimated that it will take about forty miles of ditch to reach Iowa Hill, from which place smaller ditches can be run as required.

For the supply of towns and cities the water after leaving the Tunnel at or near Soda Springs, on the west side of the mountain, will flow down the granite bed of the American River about twelve miles, where it will be taken from the river, and conducted in a suitable canal a distance of about forty miles, to a point near Auburn, in Placer County, at which point it will enter a Reservoir of convenient size to be constructed for that purpose. Leaving this Reservoir the water will enter a large wrought iron pipe, and by that means be conducted to the City of San Francisco, via Sacramento, Fairfield, Vallejo and Oakland.

The Canal to Auburn will have capacity to carry 100,000,000 gallons per day. The length of pipe from Auburn to San Francisco will be about one hundred and twelve miles, making the total distance of actual line of works to be constructed to reach San Francisco, one hundred and sixty-three miles.

## ESTIMATED COST.

I have estimated the cost of Tunnel through the Sierra Nevada Mountains as follows, viz:

Circular Tunnel ten feet diameter, with a fall of ten feet to the mile, the contents of which are 78,539 cubic feet to each foot in length—or 2.9 cubic yards to each running foot—the length of Tunnel is 26,400 feet, multiplied by 2.9 gives 76,560 cubic yards at $10.86¼ per yard, or 26,400 feet at $31.50 per foot gives $831,600
Add contingent expenses thereon, say 25 per cent. 207,900

Total cost of Tunnel..... $1,039,500

The cost of Ditch or Canal I estimate as follows:
East of Sierra Nevada Mountains, six miles at $20,000 per mile..... $120,000
West of Mountains forty miles at $20,000 per mile... 800,000

$920,000

Cost of Reservoir to be constructed at Auburn, $100,000.

Wrought iron pipe from the Town of Auburn to the City of San Francisco; I have stated the distance per line at one hundred and twelve miles, but to allow for curves I add eight miles more, making one hundred and twenty miles of pipe, for the cost of which I give copy of estimate furnished me, as follows:

"Vulcan Iron Works Company, office 135 and 137 Fremont street.

"San Francisco, February 24th, 1870.

"A. W. Von Schmidt, Esq.

"Sir:—The approximate cost of the pipe line to be constructed "will be as follows:

| | |
|---|---|
| "40 miles of 5,280 feet each, of water pipe 5 feet "diameter, of quarter inch iron..... | $2,576,076.80 |
| "40 miles of 5,280 feet each, of water pipe 4 feet "diameter, of quarter inch iron..... | 2,117,772.80 |
| "40 miles of 5,280 feet each, of water pipe 3 feet "diameter, of quarter inch iron..... | 1,692,908.80 |
| "120 miles..... | $6,386,758.40 |

"The pipe will be made here in sections of thirty feet length, "which will have to be riveted together on the ground; above "figures include the riveting together of the sections, but not the "cost of transportation.

"The weight for one mile of pipe will be respectively 931,040 "lbs.; 745,360 lbs.; 568,480 lbs.

"Respectfully yours,
"VULCAN IRON WORKS CO.,
"Per Henry J. Huttner."

This pipe is calculated to deliver at least 20,000,000 gallons of water per day in the city of San Francisco, at an elevation of three hundred and seventy feet above the city base. I estimate the cost of laying the pipe at $200,000; and the transportation thereof at $100,000.

It will however be observed that a large portion of this pipe can be less than a quarter inch in thickness; again, to save expense, the pipe should be made on the ground near where it is to be laid, thus avoiding the cost of hauling and transportation. The

dipping in Asphaltum can also be done on the ground, the expense of which will not be great, and I have included it in the above estimate.

To bring the water to the City of San Francisco, in addition to the above cost must be added the tunneling of the Straits of Carquines, amounting say to $350,000.

And extra work crossing the Bay of San Francisco which I estimate at $500,000.

I propose to cross the Bay of San Francisco in the following manner:

1.—I drive two rows of piles in pairs, six feet apart one way and one hundred feet apart the other way, across the Bay from shore to shore. I put the pipe together on a small railroad on the Alameda shore, the outer end thereof being closed up; as fast as I put the pipe together, I float it out on the surface of the water in a line between the two rows of double piles, where it remains; section after section is so added until the pipe reaches from shore to shore; while this pipe is being so floated across the Bay, an air pressure is kept thereon to prevent water from the outside filling it before the whole distance across the Bay is laid. When the pipe is ready to be lowered I stop the air supply and gradually fill the pipe with water which will cause it to sink to the bottom of the Bay and soon form its own bed; the pipe being guided by the double row of piles on either side will of course settle down in a straight line, all the pipes will have flexible joints which will permit them to form a considerable angle without breaking or leaking.

This method has been successfully used in crossing the Schuylkill River, at Philadelphia, (see annual report of the Chief Engineer of the Water Department of the City of Philadelphia, presented to the Council, February 16th, 1871, on page 14) which says: "This plan was patented by Mr. Jno. F. Ward, of Jersey City, a contract was accordingly made with that gentleman, and the Main has been successfully laid. It is thirty-six inches diameter, has a moveable joint of simple and peculiar construction, which admits its being sunk length after length from a scow, by suitable skids and derricks.

The inside of the bell of the pipe is turned smooth to a spherical form, the small end of the pipe has grooves in it to retain the lead when the pipes are put together, a lead joint is cast and caulked

in the ordinary way. The smoothness and form of the inside of the bell permits the requisite motion, the lead joint slipping upon that, whilst it is retained firmly by the grooves in the small end of the pipe."

I state the above to prove that the laying of submarine pipes has already been successfully accomplished, however I am of opinion that my plan of floating the pipe out from the shore is better than that of laying it out of a boat or scow.

In relation to the cost of line for mining purposes only, I estimate the forty miles of canal from the Tunnel, along the Ridge above mentioned, at $20,000 per mile, making $800,000, add to this the cost of Tunnel as given at $1,039,500, cost of Canal on east side of Tunnel $120,000, and twenty-five per cent. of the whole for contingent expenses, gives a total of $2,449,375, cost of line for mining purposes only.

RECAPITULATION OF ESTIMATED COST.

*For line of works from Tahoe to San Francisco,*

| | |
|---|---|
| Cost of Tunnel | $1,039,500 |
| " " Canal East of Tunnel | 120,000 |
| " " Canal West of Tunnel | 800,000 |
| " " Reservoir at Auburn | 100,000 |
| " " Pipe from Auburn to San Francisco | 6,386,758 |
| " " Laying Pipe | 200,000 |
| " " Transportation thereof | 100,000 |
| " " Tunnel Straits of Carquines | 350,000 |
| " " Crossing Bay of San Francisco | 500,000 |
| | $9,596,258 |

Say for total cost of line to San Francisco, $10,000,000.

*For Mining purposes only.*

| | |
|---|---|
| Cost of Tunnel | $1,039,500 |
| " " Canal East of Tunnel | 120,000 |
| " " " West " " | 800,000 |
| | $1,959,500 |
| Contingent expenses, 25 per cent | 489,875 |
| Total, | $2,449,375 |

*For both purposes.*

| | |
|---|---|
| To the City of San Francisco | $ 9,596,258 |
| Add the Cost of Canal along the Mining Ridge for Mining purposes | 800,000 |
| Total | $10,396,258 |

## SOURCES OF INCOME.

The Company will derive an Income from the sale of water for Hydraulic Mining; for water power for Mills and Factories along the line of works; for irrigation; and for the supply of Towns, Villages and Cities.

Only a few miles below the western end of the Tunnel, are located vast and rich gold fields of gravel and cement deposits. On the ridge lying between the North and South Forks of the American River, (the proposed line of the Company's works,) exists the largest and best gravel deposit known in the State of California. For richness it is conceded by all to be unsurpassed. The area of this immense and rich deposit is estimated to be over 30 miles in length, and an average of about seven miles in width, making in the aggregate an area of 210 square miles. This deposit is from fifty to four hundred feet in depth, yielding the precious metal from top to bottom. It will however be understood, that in this immense deposit there is some cement formation very rich, but too hard to be worked by the hydraulic process, requiring mills for crushing, but it is fair to estimate that one-fourth of the entire ground can be washed. It has been proved that from a few cents up to eight and ten dollars to the cubic yard can be relied on. Portions of this ground have been worked whenever a supply of water could be procured, during the rainy season, and always yielding a large profit. It is well known that if a constant supply of water could be obtained the whole year, it would be one of the most prosperous Mining Districts in this State, if not in the Country; untold millions of wealth would be produced that is now hidden for the want of water. No other supply than that from Lake Tahoe can be procured in quantity for want of sufficient elevation. It is safe to say that this mining ground, with all the water that can be brought upon it or made available, cannot be worked out or exhausted in a hundred years.

Miners calculate the sale of water by the inch. I calculate one miners' inch of water, with a six inch head, to run 14,400 gallons in twenty-four hours, or at the rate of six hundred gallons per hour. (See statement of J. V. Martin, in the Sacramento *Daily Union* of May 2d, 1871.)

The gold-bearing district referred to, will afford sale for at least 40,000 miners' inches of water per day throughout the year, at ten cents per inch.

I therefore estimate the income from the sale of water as follows, viz.:

*For Mining Purposes Only.*

I have calculated the quantity of water to be drawn from the Lake at 500,000,000 gallons per diem. 500,000,000 gallons daily would give, say, 34,722 miners' inches daily. The present price per inch, for a day's work of eleven hours, is twelve and a half cents, sometimes more. I will, however, calculate at the very low figure of ten cents per inch per day of twenty-four hours, which will give the following: 34,722 inches, at ten cents per inch, is 3,472 20 per day; equal, in one month of twenty-six working days, to the sum of $90,277 20—this, for one year, would amount to..... $1,083,326 40
Deduct expenses for the year..... 120,000 00

Makes net profit per year..... $963,326 40

If, however, the Company's works are completed for mining purposes, and for the supply of towns and cities also, then only four hundred million gallons of water would be used for mining purposes, and one hundred million gallons for towns and cities, in which event the revenue from mines would be as follows:

400,000,000 gallons daily gives 27,777 miners' inches daily.

27,777 inches, at ten cents per inch, is $2,777 70 per day; or, in one month of twenty-six days, $72,220 20—this, for one year, would amount to..... $866,642 40
Deduct expenses for year..... 120,000 00

Leaves net profit per year, on 400,000,000 gallons. $746,642 40

*From Towns and Cities.*

I estimate the income from towns and cities as follows:

| | |
|---|---|
| Sacramento City, one month | $4,000 00 |
| Oakland " " | 4,000 00 |
| San Francisco " " | 40,000 00 |
| Monthly income | $48,000 00 |
| Making total income from towns and cities for one year amount to | $576,000 00 |

RECAPITULATION OF INCOME.

| | |
|---|---|
| From the sale of 500,000,000 gallons of water daily, for one year, for mining purposes only, expenses deducted | $963,326 40 |

*From Towns, Cities and Mines.*

| | |
|---|---|
| From the sale of 400,000,000 gallons of water daily, for one year, for mining purposes, expenses deducted | $746,642 40 |
| From the sale of 100,000,000 gallons daily, for one year, to towns, cities, etc | 576,000 00 |
| | $1,322,642 40 |
| Deduct yearly expenses of line of works for towns and cities | 200,000 00 |
| Gives total net income | $1,122,642 40 |

The foregoing estimates of receipts may be regarded as very low indeed, especially for the city of San Francisco. The yearly revenue of the Spring Valley Water Works, at present supplying the city, is $900,000, from a daily supply of not more than 6,500,000 gallons of water. Judging from past years, it may be safely estimated that there will be an increase of receipts from this city of full ten per cent., or $100,000 per year. At this rate of increase, we have, say five years hence, from San Francisco alone, a revenue of $1,400,000 per year, according to present prices, which I consider much too high, and I have therefore only estimated the revenue from this city at $40,000 per month.

No mention is made of many smaller towns *en route* to be supplied, among others Auburn, Fairfield, Vallejo, Mare Island and Benicia, from which no inconsiderable revenue may be derived. The income from mines is also estimated at the lowest figure, and I have only mentioned the first sale of water, whereas it is the well known right and custom of Water Companies to gather the same water and sell it over again at decreasing rates.

I have estimated to take 500,000,000 gallons of water per day from the Lake. The present Dam at the outlet will admit of 822,000,000 gallons being taken daily, the water in the Lake having been raised six feet. As I before remarked, each foot of the Lake gives 137,000,000 per day, if therefore, any additional supply of water is required, the Dam at the outlet of the Lake can be raised an additional two feet, at an expense of not more than $2,500. The evaporation will not be materially increased thereby. This would be the limit that the Lake could be raised without causing damage to the low lands at the southern end of the Lake.

When the Lake is once filled the surplus water will flow over the waste weir of the Dam, and run down the Truckee River as usual.

For the past two years, the water of the Lake has been lower than ever before remembered, running to waste only 80,000,000 gallons per day, at its lowest stage, whereas when I measured it in the month of September, 1865, it run to waste 800,000,000 gallons per day.

This shows the great necessity of storing the water in the Lake by means of a Dam as I have described, to guard against dry seasons.

I would further state that I have purposely made the estimates of the cost of works very large, so as to guard against the many contingencies that may unavoidably have been overlooked or occur, in an enterprise of such magnitude in a rough mountainous country.

In an Addenda to this Report, I have given certain statistics and general information as to the Mining District on the Company's proposed line of works, furnished me by reliable gentlemen whose well-known acquaintance with the subject make their statements well worthy of full credence. Many more confirmatory reports could be obtained, but the facts are so well and generally known that I consider it unnecessary.

The actual quantity of the miners inch of water has never been definitely fixed, it varies in different districts from about 14,000 to 17,000 gallons per day, also in the size of the opening and head of water, in accordance with custom and usage, scarcely any two authorities agree upon this subject, and I have given in the former portion of this Report what I consider a fair and just estimate, and near enough for all practical purposes.

In conclusion, I beg leave to state, that I know of no other enterprise which will pay a better or surer rate of interest on the amount of capital to be invested, or that will be of greater blessing to the greatest majority of the people of California, than the utilizing of this unfailing and abundant supply of pure water.

All of which is most respectfully submitted,

A. W. VON SCHMIDT,

Chief Engineer,

Lake Tahoe and San Francisco Water Works.

# ADDENDA.

W. Van Vaetor, an old resident of Placer County, and for many years County Assessor of said County, in a report on the Mining District between the North and Middle Forks of the American River, the Company's proposed line of works, says:

"The following is the amount of gold taken out in the year 1866, from the section of Country your Canal would command when completed. The amount here given is what was shipped through the different Express offices, and what was carried out by private hands from January 1st to December 31st, 1866.

| | |
|---|---|
| "Iowa Hill, by Express | $163,633 92 |
| "Iowa Hill, by private hands | 23,100 00 |
| "Michigan Bluff, by Express | 400,000 00 |
| "Michigan Bluff, by private hands | 31,000 00 |
| "Forest Hill, by Express | 367,000 00 |
| "Forest Hill, by private hands | 28,000 00 |
| "Todds' Valley, by Express | 148,482 00 |
| "Todds' Valley, by private hands | 15,000 00 |
| | $1,176,215 92 |

The amounts given as passing through the Express office are the exact figures taken from the books in those offices. The amounts by private hands are a little under the true estimate.

The amount paid by miners during the same period for water was about $100,000.

The present supply of water for the above named localities is as follows:

Iowa Hill District including all of Township No. 7, Placer County 1,300 inches per day.

Michigan Bluffs including all of Township No. 6, 1,400 inches per day.

Forest Hill, Todds' Valley and Yankee Jims, including all of Township No. 5, 4,000 inches per day.

Township No. 8, the southern part of which could be supplied from your Canal, has a few small ditches that run water during the season of the melting of the snow, which furnish a daily supply of about three hundred inches for a short period.

This makes a total supply as you will see of 7,000 inches per day, for the whole section.

This is the maximum supply and cannot be relied on, in the most favorable seasons, for over sixty days in each year. One-half this supply might be kept up in a favorable season for seventy-five days, and one-third for ninety days. Many seasons it does not reach 7,000 inches for a single day, and frequently one-third of the hydraulic miners do not get five days run during the whole season.

Aside from this very serious difficulty in regard to the short time the present limited supply of water continues each year, in working the mines, situated so as to be accommodated by the Ditches furnishing the same, there is another that could not be obviated providing they furnished an ample supply, and that is, the ditches are too low to be used in working these mines, this difficulty applies to over half the Mining Country. This fact is very important for you to know in making your calculations as to the amount of water that could be disposed of from your canal.

Your Canal will reach the top of the main divide at a point sufficiently high to command all the mining land of this section above mentioned, providing you could furnish enough water to supply the demand.

It is the prevailing opinion among the miners here that you could sell every inch of water you can bring on the divide, and I have no doubt of this fact myself, but lest you might consider this opinion rather extravagent and not altogether warranted by the facts, I will here intrude a few figures and calculations, that I think will satisfy you that this opinion is not far out of the way.

First. If miners who are now working claims by means of Hydraulics could obtain the water to justify, they would enlarge their operations to use four times the amount of water now used. For example, the claims that now use one hundred inches would enlarge to use four hundred inches, with a very large increase of profits in proportion.

This is a fact that no miner will dispute, then; taking this as true, the miners that are now working by the hydraulic process would, if your canal was completed, instead of using 7,000 inches in the aggregate, use four times that amount, viz., 28,000 inches per day; this, at fifteen cents per inch for sixty days, the length of time water now lasts, would be $250,000 per season, and for the length of time your canal could furnish it each year, say three hundred days, would be $1,260,000.

Second. There are now as many claims in this same section being worked by drifting as those worked by hydraulicing, that would change and hydraulic their claims if water could be had.

This would require 28,000 inches more water, making in the whole 56,000 inches per day. Value, at same rate, for sixty days, $500,000; and for three hundred days, $2,520,000.

It will be observed that in this calculation I have only considered the mining ground that is so situated to be worked from the ditches now in use, were it possible for them to furnish water sufficient. This, as I have heretofore observed, does not comprise one-half of the mining land that could be worked if your canal was completed as proposed, and water could be furnished to supply the demand.

I think that these figures will satisfy you that you need have no fears of not disposing of all the water you can bring into this section.

The miners are exceedingly anxious to have you bring water here sufficient to supply them winter and summer, would do anything in their power to encourage the enterprise, and would hail the completion of this great work as the greatest blessing that could be bestowed on this community, and a lasting benefit to the whole State, as it would without doubt be a source of immense revenue to your Company.

(Signed) W. VAN VACTOR."

Copy of letter written by Mr. Philipp Deidesheimer, Mining Engineer, to Alvinza Hayward, Esq., to wit:

"San Francisco, May 23d, 1870.

*A. Hayward, Esq.*—Dear Sir:—I beg to call your attention to a project of mine, which I have carefully thought over for many years and well considered, and which to carry out, practically and successfully, the proper opportunity seems now to have arrived.

According to my judgment, based upon the long experience I have had in all sorts of mining enterprises, this is one of the most simple and strictly legitimate that has ever come under my observation, and I will therefore lay it before you in short and plain language, and conscientiously endeavor to point out to you its magnificent inducements for a profitable investment.

The mining district in question (of which I shall speak in detail more hereafter) is, as you know, located in Placer County, California. It includes your valuable mining property at Forest Hill, consisting of a rich bed of gold-bearing gravel, 1,600 feet front by 4,000 feet in depth, and an average heighth of 150 to 450 feet, which has been prospected by means of a tunnel, commenced in 1854, now 2,700 feet long, the key to that entire mining district, exposing, to a large extent, a wonderfully rich deposit of gold.

There is no further doubt in my mind that many millions of dollars are hidden in this grand deposit, and in order to get them out, I propose to you as follows:

To get the control of all the water that can be brought to and made available on, for this district. Having done this, you will be able to control the whole mining region, already prospected, extending over thirty miles in length (E. and W.) seven miles in width (N. and S.), and about four hundred feet depth, all containing a deposit of more or less gold-bearing gravel. Part of this plateau, of which Forest Hill is about the best, has been for many years, and is now, being worked very disadvantageously, on a primitive and small scale.

Most of the Companies working this district have, for the last eighteen years, extracted large amounts of money, under all possible disadvantages, of which is chiefly, the scarcity of water, yet successfully was it done in early years by mere drifting, latterly by hydraulics.

The quantity of water used for this purpose was indeed very small, for instance, the ditches supplying Forest Hill, Todds' Valley, Yankee Jims and other companies, amounting only to 1,500 inches, running from three to four months only of the entire year, and yet sustained at high wages, a population of several thousand men.

Most of this water is sold at ten cents an inch per ten hours, but miners are anxious to pay twenty-five cents for it per twenty-four hours, if it were to be had all the year throughout. To ex-

plain this more satisfactorily, a verbal exposition of the connecting details, would much facilitate the clearness of the point, which I mean to come at, and which is this, that (excepting Lake Tahoe) the only living water that can be brought into this district at comparatively small expense, is the water claimed by you, namely, the "South Fork of the North Fork of the American River," and which stream could on an average, to suit all purposes, easily provide for 5,000 inches all the year round.

The ditch to bring it would have a length of about thirty-eight miles, and could be built with Chinese labor, canal six by eight feet, within six months, at an expense of about one hundred and fifty dollars per mile. This stream of water, brought to Forest Hill, and hydraulically applied to several of the most favorable points, the proceeds of washings would certainly amount to sixty dollars per mile per month, for a great number of years (say over three years of the Baltimore front ground alone)—meanwhile with these earnings I would propose to buy the Todds' Valley Ditch, the Oro, Dardanelle and Yankee Jims' Ditches, also some good mining ground joining Baltimore claim, which I have already carefully and economically planned out, and could be accomplished at low figures. With these additional ditches and ground secured for the purpose only to control the valuable mining grounds surrounding them, the proceeds of the washings could be made to average about one hundred and twenty-five dollars per mile per month.

The ditch is not constructed with the view of selling water to other mining Companies (which in case of necessity could be done at twenty-five dollars per mile per month) but chiefly as a means to get hold of the richest mining locations and deposits along its course, and thus secure a large extent of gold-bearing ground, which, well managed, will have a value of untold millions in the course of a few years, and hold out for generations to come.

In addition, I further propose to build a wagon-road connecting with the railroad, ten miles shorter distance than the present road in use, which can be built for twenty dollars per mile, and pay for itself in two years.

The drifts to be run in all the richest strata of the ground, would ensure a handsome income, independent of the hydraulic works and facilitate the working of these.

The whole project I undertake to set into successful operation, within ten months from this, if commenced at once.

The manner in which the funds required for this undertaking are to be raised, is to be personally discussed, and can no doubt be arranged on a most profitable basis.

The amount required to be advanced within ten months will not exceed two hundred dollars per mile.

I recommend this proposition to your best consideration, and am ready any time to explain points which here may not be intelligibly enough expressed.

This grand enterprise is deserving of all our energy that we can bring to bear upon it, it will, when in full operation, stand ahead of all other enterprises of this coast and continent.

It will be a mine of wealth, and a source of pride and satisfaction to its owners and projectors.

Most respectfully,

(Signed) PHILIPP DEIDESHEIMER."

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## EXTRACT FROM THE AUBURN STARS AND STRIPES.

The Auburn *Stars and Stripes* in an article published in March, 1871, referring to the supply by the Lake Tahoe and San Francisco Water Works, for Mining purposes in Placer County, says:

"In this connection we are in receipt of a letter from Iowa Hill, dated March 13th, containing facts and estimates, from a gentleman, whose standing in the community, recognized intelligence, and facilities for obtaining correct information, entitle his statements to respect and interest."

He says: "There is on this divide, between the North and Middle Forks of the American River, the most extensive range of Hydraulic gravel deposits that can be, or has ever been found in the State, extending lengthwise of the ridge fifteen or twenty miles, divided by deep Cañons affording good outlets for working the gravel deposits on the different ridges, which deposits vary from half a mile to three miles in width, making an average width of the deposits on the main divide, of about five miles, presenting an area of more than seventy-five square miles of good gravel deposit (50,000 acres). As to the quality of the gravel it is generally conceded by experienced miners from other localities who have visited

this section, examined the character of the ground, noted the facilities we have for working, and who, to a certain extent, have practically tested the matter by prospecting, that this divide contains the best Hydraulic Mining Ground in the State.

The whole capacity of all the Ditches on this Divide is about 7,000 inches, the average time which the miners are enabled to work at Hydraulic Mining is about three months, or one-fourth of the year. The average amount of water used during said three months is about 3,000 inches, the average yield of the mines on this Divide for the last four years, has been about $1,200,000 per annum. Deducting one-third from this sum as the probable yield of Tunnel or Drift claims, we have a balance of $800,000 as the proceeds of Hydraulic Mining for three months with 3,000 inches of water per day. If with 30,000 inches per day during the whole year—which we are assured is a low estimate of what the Lake Tahoe Company can afford us, and with the additional facilities for working (*i. e.* a higher elevation of the water giving more fall or hydraulic pressure, and enabling us to work richer ground, which is now above the line of the water supply, and the advantage of working during the warm weather, when gold will best amalgamate and thus a greater portion be saved,) the proceeds from the mines on this divide will equal the yield of all the balance of California combined, as the facts and figures will fully demonstrate.

As regards the amount of water required to work the mines on this divide, 30,000 inches per day would be but a limited supply furnishing say, one hundred Companies with an average head of three hundred inches.

Three times that amount of water could be used to advantage (if such supply could be obtained) for fifty years at the very least. We have had but little water this season, the water companies endeavoring to accommodate as many as they can by furnishing different Companies alternately, a day or two at a time, so as to give all who have been to the expense of fitting up, an equal chance for working, but we are in hopes for the welfare of this section, and the balance of the Country, as well as the prosperity of the whole State, that ere long we will receive a good supply of water, when the memories of early California days will be revived."

c628.1

☞ The following Report was handed to the "San Francisco Evening Bulletin" for publication, and all the paragraphs inclosed by brackets were omitted.

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Howard, Charles Webb

# PRESIDENT'S REPORT

TO THE

## STOCKHOLDERS

OF THE

## SPRING VALLEY WATER WORKS,

JUNE 21, 1876.

# PRESIDENT'S REPORT.

*To the Stockholders of the Spring Valley Water Works:*

The facts which I have the honor to submit herewith warrant congratulation upon the prosperous condition of the Company.

During the past year the Upper Crystal Springs Dam has been constructed to the height of twenty-eight feet. Its expense has somewhat exceeded our estimates, for the reason that we were compelled to sink from ninety to one hundred and eight feet to obtain a satisfactory foundation for the puddle pit instead of from thirty to forty feet, as estimated. It will be raised to fifty feet during this season, and will make a reservoir capable of storing four thousand million gallons. [An addition of twenty-five feet (making seventy-five in all), which can be made at any time, will give it a storage capacity of 7,500,000,000 gallons, or 500,000,000 greater capacity than that of the present San Andreas Reservoir.]

We have on hand at present in the—

| | |
|---|---|
| Crystal Springs Reservoir | 1,200,000,000 gallons. |
| San Andreas Reservoir | 5,060,000,000 " |
| Pilarcitos Reservoir | 1,000,000,000 " |
| Making a total of | 7,260,000,000 gallons. |

I estimate the consumption from this supply up to the 20th November next at 12,000,000 gallons per day, equal to 1,800,000,000 for the next 150 days. To this add 300,000,000 loss by evaporation, and we have 2,100,000,000 to deduct from the 7,300,000,000 on hand, which will leave us at the commencement of the next rainy season 5,200,000,000 gallons.

We have obtained our supply, up to the present time, from ten and a half square miles of watershed; by the construction of the Upper Crystal Springs Dam we add fifteen square miles thereto, and we will acquire and store therefrom not less than 7,000,000,000 gallons during the next rainy season, to which add the supply on hand at the commencement of the rains, makes 12,200,000,000 gallons with which to commence the dry season of 1877, or more than a two years' supply.

[The water-shed from which we derive our supply is remarkably free from impurities. No other water-shed supplying water to a large city is so advantageously situated. This must continue so long as the Company owns and controls, as it now does, the larger portion of the land, aggregating about 20,000 acres, and riparian rights in addition, to a very much larger quantity.]

The Lower Crystal Springs Dam will not be required for many years. The upper dam will enable us to meet any possible demand during the next five or six years, and by that time we should have completed such substantial conduits and tunnels from the Calaveras water-shed as will furnish 40,000,000 gallons per day to the Crystal Springs Reservoir, or 35,000,000 gallons per day to the San Andreas Reservoir. This work can be accomplished by the expenditure of about $4,000,000. By an additional disbursement — not exceeding $2,500,000 — 35,000,000 or 40,000,000 more per day can be delivered from Calaveras to the reservoirs named, without taxing more than one-half of its resources. [Mr. Scowden's report shows that from December 2d, 1874, to March 1st, 1875 (120 days), 12,347,817,000 gallons of water passed the point selected for the dam at the outlet of Calaveras Valley. Our Engineer, Mr. Schussler, erected a guage at the same point, at the commencement of the rainy season of 1875–6, which shows that upwards of 58,-000,000,000 gallons passed during the season, (see table appended to this Report showing rainfall and quantity passing the gauge per day), and that, too, from less than 100 of the 235 square miles which can be utilized, and which will perpetually furnish by gravitation more than 100,000,000 gallons of water per day, when required, by an expenditure not exceeding $6,000,000; whereas, to obtain a like quantity from any other known source, on the gravitation plan,

*in a manner equally substantial*, will cost nearly if not quite $75,000,000.]

[For these immense resources, within thirty miles of our present works, we gave $1,000,000 in 7 per cent. twenty-year bonds. The property could not have been bought for less than was paid for it. It can be sold now for a much larger sum; is, in every way, the best investment the Company ever made; and, notwithstanding the efforts that have been made to impress the public with the belief that it was a bad purchase, the results will prove beyond the possibility of cavil or doubt, the wisdom and propriety of the transaction and the enormous value of the property.]

The rain-fall during the past season was as follows:

| | | |
|---|---|---|
| At San Andreas | 71.37 | inches. |
| At Pilarcitos | 65.28 | " |
| At Upper Crystal Springs | 48.11 | " |
| At Calaveras | 40.50 | " |
| At San Francisco | 33.48 | " |

During the past year we have laid 12⅛ miles of pipe, at an expense (independent of the cost of the pipe) of $12,576 65. This quantity, added to 147½ miles previously laid, makes very nearly 160 miles of distributing mains laid within the city limits. We have on the way from New York 9,000 feet of 22-inch cast-iron pipe. It will probably be in place by the middle of August next, connecting with the 22-inch wrought-iron pipe laid last year through Valencia and Market to Potter Street. It will extend easterly along Market Street as far as Sansome Street, and will add so

materially to our pressure that elevators now connected with our pipes will, we hope, be enabled to run without interruption. But, in any event, I think further connections of this sort are not to be encouraged. Elevators use a large quantity of water at once, and so reduce the pressure that water will not at all times discharge into the supply tanks on the tops of the high buildings in certain portions of the city.

[*The fact that no water works in any other city in the United States have a pressure sufficient to operate elevators, shows the superiority of our works in this respect, and also demonstrates that San Francisco is better protected against fire, so far as water supply is concerned, than any other city in this country or elsewhere, with perhaps one exception, the city of Glasgow in Scotland.*] I may add that we propose to leave in place the present main with its connections from Potter Street, through Market to Sansome Street, and to employ the new 22-inch pipe when laid as a reserve force, connecting it with the present pipe at the junction of each street running to Mission Street on the south side, and Van Ness Avenue and others intermediate to and including Sansome Street on the north side of Market Street.

There has been a disposition in some quarters to regard our charges as arbitrary and exorbitant. With regard to the first objection I have only to say that it has been our effort to deal justly and fairly with our patrons, without discrimination or prejudice, and our

rates are based upon experience in the business, which is all we can rely upon in its conduct. Notwithstanding the fact that money has been worth from 30 per cent. to 12 per cent. per annum during the entire existence of this Company, *its net receipts have not averaged 7 per cent. per annum on the actual capital invested.* [Our charges may appear exorbitant when compared with water rates charged by municipal corporations owning their own water works. In San Francisco the water supply is obtained from a private corporation, and the expense of supplying the city and its inhabitants with water and of protecting the entire property therein against destruction by fire, is borne by less than 16,000 of its 270,000 inhabitants; whereas, if, as in New York and other cities owning their own water works, the whole property therein (it being all protected and made valuable by reason of the water) contributed each its mite, as an insurance tax to make up the interest on the cost of the works, and to create a sinking fund with which to liquidate the principal, the consumers would be relieved of the larger portion of the burden they are now obliged to sustain, and would only have to pay per annum what they now pay per quarter. The tax or water rate, when levied and collected by the city as other taxes are, is paid without demurring, or the creation of prejudice such as now exists against our attempt to make the capital in this corporation pay a fair interest. The disposition to criticise and find fault with the management of

our business, probably as much as any other consideration, led to the passage by the last Legislature of two Acts relating to water, one enabling the city of San Francisco to acquire water works, and the other appointing a Commission to regulate the price at which this corporation shall sell its commodity. We are advised that the last-named Act is clearly unconstitutional and void. In the case of *San Francisco vs. Spring Valley Water Works* (48 Cal. Rep., p. 531), Mr. Justice McKinstry says: "I agree with Mr. Justice Crockett and Mr. Justice Rhodes that the Legislature can neither pass a special Act granting powers or privileges to a particular corporation created under the general law which are not enjoyed by all other like corporations under the same law, nor pass a special Act limiting or burdening with peculiar conditions the rights or powers acquired by a particular corporation from the general law. * * * *The Legislature could neither confer a benefit nor impose an obligation on the Spring Valley Water Works not conferred or imposed on all water companies by the general law.* To confer a special benefit or impose a special obligation would be equally destructive of the uniformity which it is the object of Section 31 of Article 4 of the Constitution to secure." It seems to us that the Legislature might, with equal propriety, appoint commissioners to regulate the price at which the Mission Woolen Mills shall sell its manufactures, or by sumptuary laws regulate and restrict the quantity of water and the number of

blankets the citizens shall enjoy. The Spring Valley Water Works has received no franchise, rights, favors, or privileges from the city or the State which are not equally accessible to any corporation or individual desiring to furnish water to the inhabitants of San Francisco. We supply water for the extinguishment of fires free of charge, though it costs us a large sum annually. Yet when we ask a very reasonable compensation for an unlimited additional quantity used in beautifying the public parks and squares, for hospitals, school-houses, and municipal buildings, the people are instructed that we are extortioners, monopolists, and general enemies of the human race. The Gas Company, whose mains are laid in the streets and which is in every way accommodated as much as, if not more than, this Company, contributes nothing in return, but receives more than $300,000 per annum from the city, though its commodity is not as expensive, useful, or necessary as the one we furnish.]

[It has been asserted that we are under obligations to supply water to the city for municipal purposes free of charge, because under the "Ensign Act" we agreed to do so. That Act also provided that "the rates agreed upon and fixed by a majority [of the Commissioners appointed thereunder] shall not be so low as to yield less than *twenty per cent.* per annum on the actual capital invested in said works." Unfortunately for us, the Supreme Court of this State has decided (see 48 Cal. Rep., pp. 514–515) that the "Ensign Act" is un-

constitutional, and that we must take our place with all of the other water companies in the State, under the general law, which provides that we must furnish water in case of fire, or other great necessity, free of charge. In the opinion in the case above referred to, Mr. Justice Crockett says: "Tested by the general law under which the Spring Valley Water Works is organized, *it is under no obligation to furnish water to the city and county free of charge, except for the extinguishment of fires during the pendency thereof.*" In this case the city applied for a rehearing, which was denied in an elaborate opinion, in which Mr. Justice McKinstry specially concurred, and said: "I express no opinion as to the precise meaning of the phrase 'other great necessity.' On the former appeal, and before I came to the Bench, *it was held by all the Justices qualified to sit in the case, that these words did not include every municipal purpose.* I shall assume that the construction given by the Court is correct."]

During the past year we have furnished about 4,504,000,000 gallons of water, an average of nearly 12,500,000 gallons daily. We have made 1,681 new service connections, 311 more than were made the year previous. Our total indebtedness amounts to nearly $2,700,000, the interest on which, as at present placed, amounts to about $225,000 per annum. I think it can be reduced to $190,000 very soon, and perhaps less. Our estimated income for the year ending June 1st, 1877, is $1,350,000.

[I am confident that our present system for furnishing the city of San Francisco with water is much the best that can be devised, and I see no reason why this Company, properly managed, can not go on prosperously, and fully equal all the city's requirements for water during the entire future.]

[In conclusion, I beg leave to quote a paragraph from Mr. Schussler's "Report on the Various Projects for Supplying San Francisco with Water." He says—

"I have no hesitation in saying that the Spring Valley Water Works, with their present and contemplated works, presents the only sensible and practical solution of the problem of supplying the city of San Francisco with an abundant supply of pure fresh water. It owns and controls all the sources of supply on the peninsula which can be economically utilized, together with all the desirable reservoir sites thereon; and by the Calaveras purchase it secured the next most economical source from which a large supply can be derived, and which altogether, with proper development, will furnish more than 125,000,000 gallons per day perpetually, and that, too, at an expense of not more than one-third of what it will cost to obtain, on the gravitation plan, a like quantity from any other source; and when the works have been thus developed, they will form the only basis for utilizing the water of the Sierra for supplying the inhabitants around the Bay of San Francisco."]

Very respectfully,

CHAS. WEBB HOWARD,

President Spring Valley Water Works.

# APPENDIX.

## AGGREGATE RAINFALL AND QUANTITY OF WATER PASSING THE GAUGE AT CALAVERAS.

| Date. | Rainfall in inches. | Millions gallons per day. |
|---|---|---|
| Nov. 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | 0.60 | |
| 8 | | |
| 9 | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | 0.30 | |
| 14 | 0.20 | |
| 15 | | |
| 16 | 0.15 | 50 |
| 17 | 4.00 | 1,300 |
| 18 | 3.50 | 5,600 |
| 19 | 1.50 | 2,200 |
| 20 | | 700 |
| 21 | | 250 |
| 22 | | 150 |
| 23 | | 120 |
| 24 | 0.10 | 100 |
| 25 | | 90 |
| 26 | | 80 |
| 27 | 0.30 | 150 |
| 28 | | 100 |
| 29 | | 80 |
| 30 | | 60 |
| Total | | 11,030 |

| Date. | Rainfall in inches. | Millions gallons per day. |
|---|---|---|
| Dec. 1 | 0.60 | 100 |
| 2 | | 80 |
| 3 | | 70 |
| 4 | | 60 |
| 5 | | 50 |
| 6 | | 45 |
| 7 | | 40 |
| 8 | | 38 |
| 9 | | 36 |
| 10 | | 35 |
| 11 | | 34 |
| 12 | | 33 |
| 13 | | 32 |
| 14 | | 31 |
| 15 | | 30 |
| 16 | | 29 |
| 17 | | 28 |
| 18 | | 27 |
| 19 | 0.30 | 26 |
| 20 | | 26 |
| 21 | | 26 |
| 22 | | 25 |
| 23 | | 25 |
| 24 | 1.53 | 150 |
| 25 | 0.01 | 210 |
| 26 | 0.55 | 80 |
| 27 | 0.19 | 70 |
| 28 | 0.90 | 390 |
| 29 | 0.36 | 210 |
| 30 | | 150 |
| 31 | 0.38 | 210 |
| Total | | 2,396 |

| Date. | Rainfall in inches. | Millions gallons per day. |
|---|---|---|
| Jan. 1 | | 210 |
| 2 | 1.26 | 640 |
| 3 | 0.71 | 2,350 |
| 4 | | 1,150 |
| 5 | | 680 |
| 6 | 0.61 | 820 |
| 7 | 0.80 | 940 |
| 8 | 0.01 | 680 |
| 9 | | 400 |
| 10 | | 250 |
| 11 | | 200 |
| 12 | | 160 |
| 13 | | 130 |
| 14 | | 110 |
| 15 | | 90 |
| 16 | | 75 |
| 17 | | 65 |
| 18 | | 60 |
| 19 | 0.77 | 55 |
| 20 | 0.27 | 95 |
| 21 | 0.10 | 90 |
| 22 | 0.42 | 150 |
| 23 | 1.24 | 3,800 |
| 24 | 0.22 | 1,920 |
| 25 | | 800 |
| 26 | 0.41 | 400 |
| 27 | | 300 |
| 28 | | 260 |
| 29 | | 210 |
| 30 | | 180 |
| 31 | | 165 |
| Total | | 17,435 |
| Feb. 1 | | 150 |
| 2 | | 135 |
| 3 | | 125 |
| 4 | | 115 |
| 5 | | 110 |
| 6 | | 95 |
| 7 | 1.63 | 120 |
| 8 | 2.38 | 120 |
| 9 | 0.30 | 3,100 |
| 10 | | 1,040 |
| 11 | 0.61 | 510 |
| 12 | | 640 |
| 13 | | 300 |
| 14 | | 210 |
| 15 | | 210 |
| 16 | | 190 |
| 17 | | 170 |
| 18 | | 145 |
| 19 | | 120 |
| 20 | | 95 |
| 21 | | 85 |
| 22 | | 75 |
| 23 | | 65 |

| Date. | Rainfall in inches. | Millions gallons per day. |
|---|---|---|
| Feb. 24 | 0.58 | 85 |
| 25 | 0.03 | 70 |
| 26 | 1.08 | 135 |
| 27 | 0.19 | 115 |
| 28 | | 95 |
| 29 | | 80 |
| Total | | 8,505 |
| Mar. 1 | | 65 |
| 2 | 2.19 | 180 |
| 3 | 1.31 | 4,400 |
| 4 | | 1,700 |
| 5 | 0.57 | 800 |
| 6 | 1.41 | 800 |
| 7 | 0.94 | 1,780 |
| 8 | 1.36 | 2,200 |
| 9 | | 940 |
| 10 | | 620 |
| 11 | | 360 |
| 12 | 0.43 | 380 |
| 13 | | 350 |
| 14 | | 315 |
| 15 | | 275 |
| 16 | | 235 |
| 17 | | 200 |
| 18 | | 175 |
| 19 | | 150 |
| 20 | | 140 |
| 21 | | 130 |
| 22 | | 120 |
| 23 | | 111 |
| 24 | | 102 |
| 25 | | 94 |
| 26 | | 86 |
| 27 | | 78 |
| 28 | | 70 |
| 29 | 0.34 | 85 |
| 30 | | 78 |
| 31 | | 72 |
| Total | | 17,091 |
| April 1 | | 66 |
| 2 | | 61 |
| 3 | 0.15 | 56 |
| 4 | | 51 |
| 5 | | 45 |
| 6 | | 40 |
| 7 | 0.61 | 70 |
| 8 | | 65 |
| 9 | 0.22 | 58 |
| 10 | 0.21 | 50 |
| 11 | | 42 |
| 12 | | 37 |
| 13 | | 35 |
| 14 | | 34 |

| Date. | Rainfall in inches. | Millions gallons per day. |
|---|---|---|
| Apr. 15 | | 33 |
| 16 | | 32 |
| 17 | | 32 |
| 18 | | 31 |
| 19 | | 30 |
| 20 | | 29 |
| 21 | 0.56 | 45 |
| 22 | | 43 |
| 23 | | 41 |
| 24 | | 39 |
| 25 | | 37 |
| 26 | | 35 |
| 27 | | 33 |
| 28 | | 31 |
| 29 | | 29 |
| 30 | | 27 |
| Total | | 1,257 |
| May 1 | | 25 |
| 2 | | 23 |
| 3 | | 21 |
| 4 | | 19 |
| 5 | | 18 |
| 6 | | 17 |
| 7 | | 16 |
| 8 | | 16 |
| 9 | | 15 |
| 10 | | 15 |
| 11 | | 14 |
| 12 | | 14 |
| 13 | | 13 |
| 14 | | 13 |
| 15 | | 13 |
| 16 | | 12 |
| 17 | | 12 |
| 18 | | 12 |
| 19 | 0.36 | 20 |
| 20 | | 19 |
| 21 | | 19 |
| 22 | | 18 |
| 23 | | 18 |
| 24 | | 18 |
| 25 | | 18 |
| 26 | | 17 |
| 27 | | 17 |
| 28 | | 17 |
| 29 | | 16 |
| 30 | | 16 |
| 31 | | 15 |
| Total | | 516 |

## RECAPITULATION.

| | Date. | Rainfall. | Gallons. |
|---|---|---|---|
| 1875. | November | 10.65 | 11,030,000,000 |
| | December | 4.82 | 2,396,000,000 |
| 1876. | January | 6.82 | 17,435,000,000 |
| | February | 6.80 | 8,505,000,000 |
| | March | 8.55 | 17,091,000,000 |
| | April | 1.75 | 1,257,000,000 |
| | May | .36 | 516,000,000 |
| | Totals | 39.75 | 58,230,000,000 |

# LET EVERYONE HELP TO SAVE THE FAMOUS HETCH-HETCHY VALLEY

AND

# STOP THE COMMERCIAL DESTRUCTION WHICH THREATENS OUR NATIONAL PARKS

To the American Public:

The famous Hetch-Hetchy Valley, next to Yosemite the most wonderful and important feature of our Yosemite National Park, is again in danger of being destroyed. Year after year attacks have been made on this Park under the guise of development of natural resources. At the last regular session of Congress the most determined attack of all was made by the City of San Francisco to get possession of the Hetch-Hetchy Valley as a reservoir site, thus defrauding ninety millions of people for the sake of saving San Francisco dollars.

As soon as this scheme became manifest, public-spirited citizens all over the country poured a storm of protest on Congress. Before the session was over, the Park invaders saw that they were defeated and permitted the bill to die without bringing it to a vote, so as to be able to try again.

The bill has been re-introduced and will be urged at the coming session of Congress, which convenes in December. Let all those who believe that our great national wonderlands should be preserved unmarred as places of rest and recreation for the use of all the people, now enter their protests. Ask Congress to reject this destructive bill, and also urge that the present Park laws be so amended as to put an end to all such assaults on our system of National Parks.

Faithfully yours,

John Muir

November, 1909.

## A BRIEF STATEMENT OF THE HETCH-HETCHY CASE TO DATE.

(Pages refer to more complete information contained in other portions of this pamphlet.)

The Yosemite National Park is not only the greatest and most wonderful national playground in California, but in many of its features it is without a rival in the whole world. It belongs to the American people and is among their most priceless possessions. In world wide interest it ranks with the Yellowstone and the Grand Canyon of the Colorado. The Yosemite Park embraces the headwaters of two rivers —the Merced and the Tuolumne. The Yosemite Valley is in the Merced basin, and the Hetch-Hetchy Valley, the Grand Canyon of the Tuolumne, and the Tuolumne Meadows are in the Tuolumne basin. Excepting only the Yosemite Valley, the Tuolumne basin is the finer and larger half of the Park. Practically all of the Tuolumne basin drains directly into Hetch-Hetchy Valley, which is a wonderfully exact counterpart of the great Yosemite, not only in its crystal river, sublime cliffs and waterfalls, but in the gardens, groves, and meadows of its flowery park-like floor. This park-like floor is especially adapted for pleasure camping, and is the focus of all the trails from both the north and the south which lead into and through this magnificent camp ground.

The Yosemite National Park was created in 1890 by Congress in order that this great natural wonderland should be preserved in pure wildness for all time for the benefit of the entire nation. The Yosemite Valley was already preserved in a State Park, and the National Park was created primarily to protect the Hetch-Hetchy Valley and Tuolumne Meadows from invasion.

In spite of the fact that this is a national property dedicated as a public park for all time in which every citizen of the United States has a direct interest, certain individuals in San Francisco conceived the idea that here would be an opportunity to acquire a water supply for the city at the expense of the nation. They made application to the late Hon. E. A. Hitchcock, then Secretary of the Interior, for the privilege of using Hetch-Hetchy Valley and Lake Eleanor as reservoir sites from which to draw a municipal supply of water. After giving the question careful consideration, he denied these rights on January 20, 1903, and on a rehearing again emphatically denied them December 22, 1903. (P. 10.) Thereupon a bill designed to override Secretary Hitchcock's decision was introduced in Congress but the Committee on Public Lands refused to give it standing. The matter was again taken up with the President, who referred it to Hon. Victor H. Metcalf, then Secretary of Commerce and Labor. He upheld Secretary Hitchcock's opinion and again denied the right of the city to enter a national park. When Hon. James R. Garfield became Secretary of the Interior, the city advocates renewed their efforts to have these rights granted which had been so many times refused, and at last prevailed. Secretary Garfield on May 11, 1908, rendered an opinion so prejudicial to the interests of the American public in their National Parks, as to practically nullify the whole national park policy and throw those great public playgrounds open to all kinds of destructive invasion from local and comparatively private interests. Fortunately the rights granted by Secretary Garfield, if they possess any legality

at all (p. 11) are revocable at the discretion of any Secretary of the Interior. Armed with this Garfield permit to flood the Hetch-Hetchy Valley and destroy its use as a public playground, the Park invaders again applied to Congress in December, 1908, to confirm Garfield's action and render it irrevocable by securing title to the floor of Hetch-Hetchy in fee simple. The matter was referred to the Public Lands Committees of the House and Senate for recommendation. While a majority vote of eight in the House Committee favored the abandonment of this priceless national property, there were seven who voted against it, and one other member later joined the minority, making the vote a tie. (P. 22.) Many friends of the National Park system were ready to champion the people's cause if the bill had reached the floor of the House, but the closing days of the session made it impossible to have the bill brought up. Before the Senate Committee the bill did not fare as well and it became known that, if brought to a vote, the result would have been unfavorable to San Francisco and this would have been fatal to future attempts to pass the bill. Therefore, the bill died with the Sixtieth Congress.

The same bill has been re-introduced in the present Congress, and a last desperate attempt to force it through will be made.

If San Francisco could not obtain pure water elsewhere, this great national sacrifice might be justified, but hydraulic engineers of unquestioned standing have reported on many other adequate and available sources. In this respect, probably, no large city in the world is more favorably situated. (Pp. 4-6.)

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The unnecessary destruction of Hetch-Hetchy Valley is being opposed by the

SOCIETY FOR THE PRESERVATION OF NATIONAL PARKS
AMERICAN CIVIC ASSOCIATION
AMERICAN SCENIC AND HISTORIC PRESERVATION SOCIETY
PLAYGROUND ASSOCIATION OF AMERICA
GENERAL FEDERATION OF WOMEN'S CLUBS
CALIFORNIA AND OTHER STATE FEDERATIONS OF WOMEN'S CLUBS
AMERICAN ALPINE CLUB
SIERRA CLUB OF CALIFORNIA
APPALACHIAN MOUNTAIN CLUB OF BOSTON
MAZAMAS OF PORTLAND
MOUNTAINEERS OF SEATTLE
CHICAGO GEOGRAPHICAL SOCIETY
SATURDAY WALKING CLUB OF CHICAGO

And innumerable other leading Clubs throughout America

**. . . . to permit a municipal corporation to intrench itself in the Yosemite National Park, no matter how good that corporation promises to be, seems to "The Outlook" an indefensible and dangerous piece of inconsistency which will be thoroughly bad not only in its immediate effect but as a precedent for future action.**—Editorial in N. Y. "Outlook," January 30, 1909.

**Where is the justice in taking what has been already dedicated to the American public merely to save San Francisco's dollars?**

## MANY OTHER WATER SUPPLIES ARE AVAILABLE FOR SAN FRANCISCO.

> "Let us say at once that we hold human life more sacred than scenery, than even great natural wonderlands, vastly as they contribute to save life and promote happiness; and if that were the issue, if San Francisco could not otherwise obtain an abundant water supply, we should be willing to dedicate to that purpose not only Hetch-Hetchy, but even the incomparable Yosemite itself."—*Editorial by R. U. Johnson in "Century Magazine."*

One of the first questions asked by those seeking information on this subject is whether there are other supplies available for the use of San Francisco. There are many. We have always favored going to the mountains for pure water.

Look at a map of California. San Francisco is situated near the confluence of the two great rivers of the State,—the Sacramento and the San Joaquin. Tributary to these rivers and flowing west toward San Francisco down the Sierra are several large rivers, (among them the Tuolumne) any one of which will furnish ample water for San Francisco. North and South of San Francisco along the coast many streams waste their waters in the ocean. It is doubtful whether any other city in the world of the size of San Francisco has so many available water supplies. It is ridiculous to assert that the only water available for San Francisco runs down the Tuolumne shingle of the great Sierra roof.

## WHAT OUR OPPONENTS AND EMINENT ENGINEERS SAY ABOUT OTHER WATER SUPPLIES.

C. E. Grunsky, former city engineer of San Francisco, and sometimes referred to as the "Father of the Hetch-Hetchy system," says:

> "In the case of San Francisco, there is no single source of supply so pre-eminently available that it could without question rule out others from comparison."—*p. 15 of Reports on Water Supplies of San Francisco,* 1908; *p. 385 House Committee Hearings, January 21,* 1909.

Professor C. D. Marx, one of the city's hydraulic experts, has stated that

> "It can readily be shown that the drainage area needed for a water supply capable of furnishing 200,000,000 gallons per day can be had on a number of the Sierra streams. . . . That the drainage areas of streams north of the Tuolumne give better promise of meeting these requirements, cannot be denied. . . . It cannot be said that the physical data now available are such as to admit of a reliable comparison of the relative values of the various sources of water supply for San Francisco from the Sierras."—*Transactions of Commonwealth Club, June,* 1907.

> "Mr. Phelan—There are no less than half a dozen water supplies from the Sierras. . . . Mr. Hammond—We have listened to the engineers, but I did not understand that the Tuolumne is the only Sierra supply. Mr. Phelan—By no means."—*Testimony before the Public Lands Committee of the House, January 21, 1909, p. 342.*

> "Without a doubt the city can obtain water from half a dozen other sources which are now owned by private interests. . . ."—p. 36.
>
> "It is simply a question of which of the various sources of supply is the best one for the city of San Francisco to take. . . ."—p. 38.
>
> "Without doubt the city has the right, under California law, to condemn." —p. 38. *Secretary Garfield in hearing before Public Lands Committee of House, January 9,* 1909.

> "We do not deny that there are other sources of supply up and down the Sierra Nevada Mountains. . . ."—*J. D. Galloway, p. 387, Hearings, January 21,* 1909.

In a brief filed by the San Francisco city attorneys in June, 1909, in the United States Circuit Court, Ninth Circuit, Equity Case No. 13,395, appears the following language used in behalf of the city in that suit (pp. 520-523):

> "The testimony discloses that several other substitutes (for the Tuolumne system) are available for the use of San Francisco." . . . (Elaborate quotations from the testimony are made to demonstrate this fact.) "It appears from the evidence, therefore, that the Tuolumne is but one of the several possible sources from which a substitutional supply might be obtained."
>
> "When you consider the matter of money alone, there are available quite a number of sites and a number of sources, probably more than a dozen."—*Marsden Manson, City Engineer of San Francisco, Senate Hearings, p.* 123.

James D. Schuyler, hydraulic engineer of Los Angeles, says that there are

> "A number of other available sources of water supply for San Francisco." —*Hearings, January 20, 1908, p.* 307.
>
> " . . . It is feasible to provide an ample supply of pure water for San Francisco from nearer sources (than the Hetch-Hetchy) by works which would be much more economical, efficient, and reliable. . . . They can be developed to supply all the water required for the next 40 or more years." —*Frederick P. Stearns, Chief Engineer of the Metropolitan Water Board that supplies Boston (pp.* 308, 311, *Journal of the Association of Engineering Societies, December,* 1908). Schuyler and Stearns were consulting engineers on the Panama Canal.
>
> "I do not consider that the Tuolumne (Hetch-Hetchy) supply would furnish a greater quantity of water, nor a water of better quality, than can be obtained from nearer sources."—*Rudolph Hering, the hydraulic engineer of New York and Philadelphia (testimony in Equity Case No.* 13,395).

Colonel W. H. Heuer, U. S. A. Engineer and chairman of the Executive Committee of the Federated Water Committee of San Francisco, states that the present nearby sources

> "Can be increased by additional dams and raising some existing dams, so as to supply considerable more than 100 million gallons per day, or more than enough to supply the wants of San Francisco during the next forty years, and at reasonable cost. . . . Engineers who made surveys of Lake Eleanor and Hetch-Hetchy inform me that there are other Sierra supplies which can be brought here at much less cost than Hetch-Hetchy. The latter by persistent advocates has been preached, almost forced, into acceptance by the people of San Francisco."—*San Francisco Merchants' Association Review, July,* 1908.

This view receives further corroboration from C. E. Grunsky (pp. 164-6, Sept. '08, *Journal of the Association of Engineering Societies*), Prof. Geo. Davidson, U. S. Coast and Geodetic Survey, and other engineers. San Francisco now uses only 35,000,000 gallons per day.

On the Feather River is the Big Meadows reservoir site of about 20,000 acres. At the outlet of the Meadows the topography is such that by the construction of a comparatively small dam a storage reservoir can be created which will be one of the largest artificial bodies of water in the world, having a capacity of over 280,000 million gallons, or four times the greatest capacity of the Hetch-Hetchy reservoir. This water could be brought to San Francisco if necessary.

## DEFEND OUR NATIONAL PARKS.

The precedent involved is one most dangerous to the welfare of the national parks generally, and the establishment of a reservoir in Hetch-Hetchy will compel a tremendous sacrifice in notable scenery and in public recreation grounds.

Every citizen who believes in preserving the integrity of our national parks, everyone who regards these scenic treasures as national resources, hitherto supposed to be safeguarded for the benefit of all the people, should protest.

Object to the surrender of any public land in any national park, and urge the need of extinguishing all private claims through purchase by the government.—By *Appalachian Mountain Club.*

## A DOZEN SOURCES OF WATER SUPPLY ARE AVAILABLE FOR SAN FRANCISCO.

1. Advantage of the STANISLAUS RIVER as a source of supply for San Francisco:—Collecting basin "adequate in area, with pure waters" (Marsden Manson, City Engineer). River rises in high granite mountains similar to Tuolumne and not in a national park. No scenery comparable to Hetch-Hetchy, Tuolumne Cañon and Meadows, hence no danger of contamination from increasing tourist travel; rainfall heavy; watershed protected by forest reserve; pipe line to city shorter than to Tuolumne supply; ample storage at Donald's Flat, Relief, and Kennedy reservoir sites; dams already constructed by Stanislaus Power Co., and to be constructed, thus insuring uniform maximum flow of water. Power company will sell ample power to pump water over coast range practically at cost. Saving by having dams and power plants already built will offset the comparatively small cost involved in purchasing full right to water. Company has guaranteed water rights and supply of water equal to all of city's requirements. City has paid no attention to offer to build system and deliver water for ten per cent added to bare cost.

2. Advantages of the EEL RIVER as a source of supply.—Uninhabited mountain watershed in forest reserve, 325 square miles tributary to diversion point; 268 square miles tributary to Gravelly Valley reservoir; water rights guaranteed perfect; average annual rainfall, 50 to 60 inches; capacity of reservoir with 150-foot dam, 70,000 million gallons, or twice the capacity of Hetch-Hetchy Valley with the same height of dam; dam crest, 600 feet; 1500 feet of drifts already run demonstrate good character of dam foundation; 100-foot dam will be completed by fall of 1911; tunnel already constructed diverts flow to Russian River basin. Water can be diverted at waste gates or allowed to flow down Russian River to Cloverdale gravel beds and filtered naturally and piped to San Francisco via San Pedro and San Pablo Point crossing. This crossing can be accomplished by flexible pipe lines similar to those which have been in service at Dumbarton for twenty years. San Pablo crossing is only a little longer and deeper, and cost of lines carrying 60 million gallons daily has been estimated to be only about $1,500,000. Distance to distributing reservoirs less than Tuolumne. Gravity system following California and Northwestern Railroad grade, saving excessive costs of transportation and heavy pipe. Water would be taken through Berkeley and Oakland, thus supplying all bay cities at smallest expense. A. M. Hunt, an engineer familiar with water problems of San Francisco, reports that this water supply is ample and can be brought to the city for one-half the expense of bringing in an equal amount from Tuolumne system. Power company offered to sell water rights to city for very small figure, but city paid no attention to offer.

3. Pumping from SAN JOAQUIN RIVER as source of supply.—When nearby sources (which unbiased engineers report can be developed to three times present daily use of city) are exhausted, by pumping from San Joaquin River just below Altamont, city can secure all the additional water she wants free of cost; can filter to any degree of purity; saving in head works, length of pipe line, rights of way, water rights, power plants, etc., would more than offset fixed pumping charge and cost of filtration. Supply is always available and need not be resorted to until necessity arises.

4.—SACRAMENTO RIVER.
5.—LAKE TAHOE.
6.—YUBA RIVER.
7.—FEATHER RIVER.
8.—AMERICAN RIVER.
9.—MOKELUMNE RIVER.
10.—COSUMNES RIVER.
11.—CLEAR LAKE.
12.—BAY SHORE GRAVELS.
13.—PRESENT SUPPLY ADDED TO SAN GREGORIO, PURISSIMA, PESCADERO, CALAVERAS, ALAMEDA, Etc.

We do not contend that all of these supplies are suitable, but many of them are.

. . . . **while the Yosemite National Park might very properly be sacrificed to save the lives and health of the citizens of San Francisco, it ought not to be sacrificed to save their dollars.**—Editorial in N. Y. "Outlook," January 30, 1909.


*Read carefully pp. 20-21 and help to save the Park.*

## THE EFFECT OF USING HETCH-HETCHY AS A MUNICIPAL RESERVOIR.

*Direct Effect.*—To flood the floor of the valley as proposed will destroy its use by the public. The floor of this valley is four and a half miles long, averaging half a mile in width and almost level. It is beautifully wooded, being pronounced by Mr. George Frederick Schwarz, forestry and landscape expert, who studied in forest schools of France and Germany, after a careful examination, as "the most beautiful natural parkland" he had ever seen, and that in its wonderful forest growth of great variety and magnificent development it surpassed the Yosemite Valley itself.

## IT IS A PARADISE FOR CAMPERS AND CAN ACCOMMODATE THOUSANDS.

It is one of the three great camp grounds in the Park—the others being Yosemite Valley and Tuolumne Meadows. All of the trails in this portion of the Park radiate from Hetch-Hetchy. It is the natural gateway to the wonderfully beautiful mountain region lying east and north of the valley. The walls of the valley are steep, perpendicular Yosemite-like cliffs. The Commonwealth Club of San Francisco, through a committee appointed to investigate this very question, recently reported as follows:

> "More important than the loss of scenic beauties we consider the loss of the opportunities of public enjoyment of them. At present any one may go and freely camp in the Hetch-Hetchy Valley and stay as long as his inclination permits. If the valley is made into a reservoir, however, the camping-grounds will be destroyed as a place to visit, and the Hetch-Hetchy Valley will have been taken from the camper's map. . . .
>
> "The importance of the Hetch-Hetchy Valley as an entrance path into the upper Sierras has been very strongly urged by those who presented their objections to Congress. While Hetch-Hetchy is now used for such a purpose by but few, it is probable that it would be so used by a very much larger number in the future, if the valley remained available. To the extent that this is true, the flooding of the valley is a serious matter to the mountain-climber. It is the natural camping base and the natural place for rest and recuperation from fatiguing journeys into the upper territory."

Imagine the floor of Yosemite Valley flooded! Where would there be the possibility of visiting the place and enjoying it. Every argument in favor of flooding Hetch-Hetchy is equally applicable to flooding Yosemite itself. There are no camping possibilities on or near the steep walls or cliffs of Hetch-Hetchy. There is one small shelf above the lower end of the valley where a few could be accommodated. Feed for animals would last but a few days. The Superintendent of the Park informed us that though he wished to do so, he could not camp there for lack of drinking water, which disappears early in the season. Along the traveled approach to the valley, the nearest camping places for parties of any considerable size are from eight to ten miles distant.

. . . . **If the Hetch-Hetchy Valley is turned into a reservoir, it will be for the purpose of supplying the city of San Francisco with water for drinking, washing and industrial purposes. These purposes cannot be hygienically carried out without careful supervision, not only of the Tuolumne River and the beautiful camping meadows near its head, but also of the watersheds on the north and south.**—Editorial in N. Y. "Outlook," January 30, 1909.

## TRAVEL INTO THE ENTIRE TUOLUMNE WATERSHED, BY FAR THE FINER HALF OF THE PARK, WOULD BE JEOPARDIZED.

*Indirect Effect.*—Five hundred square miles of the Park drain directly into the proposed municipal system. Immediately above the valley itself and extending to the very source of the Tuolumne River, which flows through the Hetch-Hetchy, is the most wonderful scenery in the Park, including as it does the Grand Canyon of the Tuolumne, nearly a mile deep, with its stupendous cliffs and waterfalls, and the magnificent Tuolumne Meadows at the head of the canyon, which are by far the most delightful and interesting high mountain camp grounds in the High Sierra. Travel to all of these natural wonders will be restricted if a municipal water system is allowed to store water which drains from these camp grounds.

Marsden Manson, the city engineer, in an official report on this system says "that at no time in the future can conditions arise tending to impair the purity of the water flowing therefrom, *which can not be rigidly controlled.*" Think of a city controlling all the people of the United States in their enjoyment of their own park!

"Argument is scarcely necessary to indicate the impossibility of permitting public access to a reservoir intended to furnish a domestic water supply to any large center of population. The danger of pollution which would thus result would make the water supply thus acquired a menace instead of a benefit to the people of the city involved. One case of 'walking typhoid' on the borders of the lake proposed to be established as a reservoir could start an epidemic of typhoid fever in the city to be supposedly benefited, causing the loss of hundreds of innocent lives. Countless experiences prove the correctness of this statement. The city of Reading, Pennsylvania, has had eight hundred cases of typhoid fever within less than eight weeks through the pollution of a supposedly guarded water supply. The epidemics at Plymouth, at Ithaca and elsewhere are well-known to have resulted from exactly the conditions which might be expected in respect to the city of San Francisco. It is thus apparent that full public access to the lake and the valley in which it shall be created can not be had if the health of the people of the city of San Francisco is of any importance to those who are seeking this water supply.

"Not only in the reservoir itself would danger from pollution exist, but a greater danger would arise through the possible pollution of the watershed feeding the reservoir proposed. A single case of 'walking-typhoid' again affecting a camper, or stroller, or ordinary visitor, who had acquired that typhoid on his way into the park, could make the proposed water supply a source of desperate danger to the city supposed to be benefitted. Nothing is better established in modern sanitary science than that the watershed of any domestic water supply must be jealously guarded and kept free from human occupancy at all times if that water supply is to result in other than the dissemination of disease and the bringing about of untimely death. No suggestion is made that the city of San Francisco has considered the filtration of the supposed water supply just preceding its use, but much urgency is put upon the purity of the supply which is to be obtained within the Yosemite National Park. It is therefore obvious that if this purity is to be maintained, the whole watershed of the Hetch-Hetchy and Lake Eleanor reservoir sites must be given up to the purposes of the domestic water supply of the city of San Francisco. I am credibly informed that this involves the taking of an area but slightly less than half of that of the whole Yosemite National Park itself. If this be the intention of the proponents of this plan, it should be so definitely stated and the country should know that nearly one-half of an area of unequaled natural beauty, set aside by Congress as a great national park and playground, is to be given up to the purposes of the city of San Francisco, without any showing publicly made that there is no other source of water supply which would be less expensive to the people of the United States, whose property it is thus proposed to divert."—By J. Horace McFarland, President of American Civic Association, who has given the subject of sanitation of municipal water supplies careful consideration.

## SAN FRANCISCO WANTS WATER POWER AT THE EXPENSE OF THE NATION.

The park invaders object to these other available water supplies because the water power rights have largely passed into private ownership. This is the crux of the whole situation. (See article by Marsden Manson, .City Engineer, in *California Weekly*, June 18, 1909.) The same paper says editorially:

"It is the possibility of a power supply that makes this proposition preeminently attractive."

" . . . the other water supplies were all in private ownership. Of course the city could condemn and acquire these supplies. . . ."—*Mr. Phelan's testimony before Public Lands Committee, U. S. Senate, p. 26.*

Both Mr. Phelan and Mr. Manson, the City Engineer, say, "it is a matter of money." (p. 386, House Hearings.)

"There are no less than half a dozen water supplies from the Sierras, but they are all obstructed by ownership, developments made by power companies, used by power companies. . . ."—*Mr. Phelan, House Hearings, p. 342.*

The development of power does not consume water. It is still available for the city. The city would have to buy power for pumping. This expense would be offset by the fact that the city would not have to expend millions of dollars in construction of dams and power plants. The power companies have done and will do this. In short, the city asks the nation to make her a priceless gift in order to save herself from having to pay the difference between the cost and the market price of water power.

The creation of the park has heretofore prevented the private acquisition of the power and water rights in Hetch-Hetchy. The city has slumbered while other power and water rights in the Sierra have been acquired by others. In order to save a few dollars the city now demands the sacrifice of a national park and would selfishly destroy a wonderland which wise and patriotic foresight has preserved all these years for the American people.

## THE BEAUTIFUL LAKE FALLACY.

Landscape gardens, places of recreation and worship, are never made beautiful by destroying and burying them. The beautiful lake forsooth would be only an eye-sore, a dismal blot on the landscape, like many others to be seen in the Sierra. For, instead of keeping it at the same level all the year, allowing Nature to make new shores, it would of course be full only a month or two in the spring, when the snow is melting fast; then it would be gradually drained, exposing the slimy sides of the basin and shallower parts of the bottom, with the gathered drift and waste, death and decay, of the upper basins, caught here instead of being swept on to decent natural burial along the banks of the river or in the sea. Thus the Hetch-Hetchy dam-lake would be only a rough imitation of a natural lake for a few of the spring months; an open mountain sepulcher the others.

## A FALSE ISSUE RAISED BY THE CITY'S ADVOCATES.

The advocates of this plan for securing water are loud in their protestations that a mere handful of nature lovers who visit this region now are trying to stand in the way of the acquisition of a pure water supply for the "poor widows and orphans of San Francisco" and the half million who live about the bay. This accusation is unqualifiedly false. There are none more anxious than we that San Francisco should own and control a bountiful supply of the purest mountain water. As we have pointed out elsewhere, it is not necessary for her to invade and dismember a National Park in order to do this.

HON. E. A. HITCHCOCK, SECRETARY OF THE INTERIOR, DENIED SAN FRANCISCO THE USE OF HETCH-HETCHY VALLEY AS A RESERVOIR, DEC. 22, 1903, SAYING:

"It is proposed to convert Lake Eleanor and Hetch-Hetchy Valley, respectively, into reservoirs for the storage of a water supply for the city. Both are admittedly scenic features of the Yosemite National Park. . . . Hetch-Hetchy Valley is widely known for its wonderful natural conditions and marvelous scenic interest. . . .

"The Valley proper is about three and one-half miles long and of a width varying from one quarter to three quarters of a mile. The rugged granite walls, crowned with domes, towers, spires and battlements, seem to rise almost perpendicular upon all sides to a height of two thousand five hundred feet above this beautiful emerald meadow. . . .

"If natural scenic attractions of the grade and character of Lake Eleanor and Hetch-Hetchy Valley are not of the class which the law commands the Secretary to preserve and retain in their natural condition, it would seem difficult to find any in the park that are, unless it be the Yosemite Valley itself. In the absence of the clearest expression to the contrary, it is inconceivable that it was intended by the Act of February 15, 1901, to confer any authority to be exercised for the subversion of those natural conditions which are essential to the very purposes for which the park was established.

"Presumably the Yosemite National Park was created such by law because of the natural objects, of varying degrees of scenic importance, located within its boundaries, inclusive alike of its beautiful small lakes, like Eleanor, and its majestic wonders, like Hetch-Hetchy and Yosemite Valley. It is the aggregation of such natural scenic features that makes the Yosemite Park a wonderland which the Congress of the United States sought by law to preserve for all coming time as nearly as practicable in the condition fashioned by the hand of the Creator—a worthy object of national pride and a source of healthful pleasure and rest for the thousands of people who may annually sojourn there during the heated months.

"Having in view the ends for which the Park was established and the law which clearly defines my duty in the premises, I am constrained to deny the application."

## VIEWS OF HON. JOHN W. NOBLE,

FORMER SECRETARY OF THE INTERIOR.

Upon the policy of surrendering the Hetch-Hetchy Valley and its surroundings to the use of the city of San Francisco for water supply, allow me to express to you my conviction that such appropriation should not be made.

Permit me also to recall that during the Harrison administration these reservations, in connection with Yosemite Park, were discussed and advanced, with the system then inaugurated of protecting our natural and wonderful scenery and our forests and other resources. It took labor and moral courage to withstand the fierce opposition of local interests to do this.

Among the most important reservations secured were these now asked for a city to be abandoned. It ought not to be done. The city has abundant water supply other than the reservoir to be constructed here, and it is not necessary to give this up.

There is a growing public opinion in favor of a strict *preservation* of what has already been redeemed for national reservations; and an appropriation of this, one of the chief works of John Muir's patriotic foresight, will be deemed a surrender of the national policy and a return to the idea that the nation has nothing that cannot be appropriated to other interests sufficiently persistent in assertion

## THE GARFIELD PERMIT TO FLOOD HETCH-HETCHY VALLEY IS INVALID.

The Act of 1890 creating the Yosemite National Park was a special act having for its object the preservation of Hetch-Hetchy Valley and other wonders of the park in their natural condition, and none of its terms could have been repealed by the passage of the general law of 1901 authorizing the granting of rights of way, etc., by the Secretary of the Interior unless that intention were expressly declared in the general act, and there is no such language to be found in the act. Only rights of way, etc., which will not destroy the natural condition of wonders of the park are within the contemplation of the act of 1901.

It is the opinion, therefore, of many lawyers of high standing that:

> "The action of the Secretary of the Interior of May 11, 1908, in granting the permit to flood Hetch-Hetchy Valley, was without authority of law. Such was the opinion of his predecessor in office, Honorable E. A. Hitchcock, (letter to the President of February 20, 1905), who was supported by the opinion of Honorable V. H. Metcalf, Secretary of Commerce and Labor. (Letter to the President of March 1, 1905.) The latter wrote: "As the law now stands, permission to use the reservation for purposes which will permanently change its natural conditions *may be granted only by Congress.*" The reasons for this view, as set forth by Mr. Hitchcock, are that "The act of 1890 (establishing the park) makes it obligatory to preserve and retain the *natural curiosities and wonders of the park in their natural condition.*" The act of 1901, under the authority of which this permit has been obtained, allows grants of *revocable* rights of way "which are not incompatible with the public interest." "It is inconceivable," says Mr. Hitchcock, "that it was intended by the act of 1901 to confer any authority to be exercised for the subversion of those natural conditions which are essential to the very purposes for which the park was established. This is the common sense construction of the two acts."—*From Brief of Appalachian Mountain Club.*
>
> "Secretary Hitchcock said that public interest meant the preservation of the natural curiosities and wonders in their natural condition. Secretary Garfield said it meant a water supply for San Francisco, as that was the highest beneficial use. A study of the records of Congress will show, however, that Secretary Hitchcock grasped the real meaning of the later act. The Committee on the Public Lands, in reporting the act of 1901, said:
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> > "The several acts relating to this subject should be brought together and harmonized in a new act, the terms of which should be broad and comprehensive enough to afford the widest possible use for all beneficial purposes of the waters on the public lands and reservations of the United States, **so long as the same is consistent with the preservation of the public interests and the attainment of the purposes for which the various reservations are established.**"
>
> "From the foregoing it would seem that it was the intention of the Committee, and presumably the intention of the Congress, that the act should be availed of in a way that would not destroy the purposes of the park, which were the preservation of objects of beauty. And of those Hetch-Hetchy was notably one."—*From Report of Hon. Herbert Parsons, Member of the Committee of Public Lands of the House*, p. 27, Report No. 2085; 60th Congress, 2nd session.

**"It is not within my power under the guise of giving a revocable right of way to give away one of the wonders of the park."—Hon. E. A. Hitchcock, former Secretary of the Interior.**

## HETCH-HETCHY AND THE YOSEMITE PARK IS A GREAT NATIONAL ASSET.

According to the terms of the Garfield permit, San Francisco must first develop Lake Eleanor and Cherry River to their greatest capacity. It would be fifty years before Hetch-Hetchy Valley could possibly be used. Who can foretell what the travel to the Hetch-Hetchy will be by that time? It is now numbered by the hundreds annually and in fifty years will reach so far into the thousands as to be almost unbelievable. A hundred years ago the travel into the Alps was negligible. Now it has become the "Playground of Europe" and consular reports indicate that over two million persons travel to the Swiss Alps annually.

If San Francisco should secure the legislation she seeks granting her the floor of Hetch-Hetchy, it would mean that the destruction of the valley would only be a matter of time. How much more rational to let this question of the necessity for using the valley be determined when that necessity actually arises. The valley will remain in the park and can not be acquired by others. This situation demonstrates the sophistry of the water system advocates. They are afraid to let this question remain open to be decided by those who fifty years hence are rightfully entitled to decide it. If allowed to increase without restriction, travel to the Hetch-Hetchy fifty years from now will be so great as to make any scheme to destroy it unthinkable. The value of the Yosemite National Park as a commercial asset is simply incalculable. It is a gold mine for the State of California and a treasure house for the whole nation. The Hetch-Hetchy Valley is one of its most priceless attractions, and no community would suffer greater loss by the destruction of Hetch-Hetchy than San Francisco herself.

"The value of great scenic possessions is being increasingly recognized the world over. This value is now known to have a great influence upon the development of that best citizenship, without which a country is poor indeed. It is also admittedly understood to relate very closely to the maintenance of the health of the people. There is, too, a recognized and most definite value in the maintenance of great scenery as a directly productive asset, attracting travel from all the world. It is admitted that more than twenty millions of dollars are annually expended in travel to see the Falls of Niagara. Capitalized at five per cent, and taking no account of the increasing travel, this would make the travel value alone of this one asset of American natural scenery exceed four hundred millions of dollars. The travel tribute paid to the Yosemite National Park is annually increasing, and as our population increase it must increase in larger proportion; for more and more are men driven for necessary rest and recreation to the few remaining spots presenting undamaged nature's sublimest works. It may therefore be assumed, I insist, that all of the Yosemite National Park, which in its wisdom Congress set aside many years ago for just the purpose I have been urging, holds a very large value, inhering to all the people of the United States. This value, I insist, should not be interfered with except for a grave public necessity, and for cause fully shown to the satisfaction of the whole country, who own the Yosemite National Park."—J. Horace McFarland, President of American Civic Association.

**"Conservation of our natural scenery is conservation of one of the nation's greatest resources.**

**"This threatened precedent of entering National Parks is wrong in principle and unnecessary in fact.**

**"There is a vast economic reason for jealously guarding all of our scenic heritage in America."—J. Horace McFarland, President of American Civic Association.**

## OTHER ARGUMENTS OF THE PARK INVADERS ANSWERED.

Those who would enter and destroy vital and essential features of our great national parks give as a reason that the Hetch-Hetchy Valley is flooded by the spring freshets of the Tuolumne River. The facts are these: For a few days in the spring portions of the lower end of the Hetch-Hetchy Valley are covered with water. The upper two-thirds, embracing the most beautiful parts of the park-like floor, is never flooded. After the water recedes from the lower portion, it leaves a dry sandy soil which becomes one of the most beautiful flower gardens in the Sierra. The Yosemite Valley floor is subject to the same periodic and extensive flooding at seasons of high water.

The floor of Hetch-Hetchy Valley has been called a "mosquito marsh" by our zealous opponents. There are mosquitoes there in great numbers immediately following the spring overflow of the lower end of the valley, but they remain but a short time and disappear entirely when the water is drained off from the sandy flower gardens and meadows, as nature quickly accomplishes. Drainage and a liberal use of petroleum will eradicate even this temporary nuisance. There are great numbers of mosquitoes even in the Yosemite Valley itself. Let us drown the Yosemite if this argument is tenable.

They argue that Hetch-Hetchy Valley is accessible only a few months in the year. With good roads it can be made accessible the whole year round, as the Yosemite Valley has recently been made accessible.

The park invaders urge that but few visit Hetch-Hetchy Valley now and that the needs of a great city are paramount to the pleasures of a few. The same argument would have applied to Yosemite before good roads were made. We are not judging the needs of the Hetch-Hetchy Valley by present travel there. With good roads and trails connecting it with the Yosemite and the other important places in the park, travel to Hetch-Hetchy will increase just as travel to the Yosemite has increased.

They urge that the city now owns all the patented land on the floor of the valley and that this bill in Congress merely provides for the exchange of other lands so that the city can secure control of the entire floor in fee simple. San Francisco has acquired by purchase some 720 acres in and about the floor of the Hetch-Hetchy Valley. In order to cover fully the rights she desires she will need about 2000 acres more that now belong to the American people and is a part of the national park. It is unfortunate that the nation ever parted with any of its title to these lands, but it is one of those mistakes made in the early days when our public domain was parcelled out without regard to consequences. This land was acquired under the guise of homesteads, etc., and in reality was used for a few years for pasturing sheep and stock. The government at that time never realized how priceless it was. The creation of the national park put an end to further sacrifice of one of the nation's most valuable possessions. Now these park invaders argue that because the government made the monumental mistake of ever parting with title to an acre of this wonderland, it shall now commit the irretrievable folly of sacrificing it all! The land the city owns is valueless for reservoir purposes without acquiring control over all the remainder. The government called a halt when it created the park, and a wise policy will decree that the land which it foolishly patented before the creation of the park shall be either purchased or condemned like other private claims in other national parks.

## UNEQUAL NATURE OF PROPOSED EXCHANGE BY THE CITY.

The city proposes through the bill now pending in Congress to exchange for lands on or near the floor of Hetch-Hetchy an equal acreage of patented lands—some situated within the national park and some not even in the park, but in the adjacent forest reserve. The Hog Ranch is one of the tracts lying just outside the present park boundary. It is like thousands of other Sierra pastures, and to exchange Hetch-Hetchy Valley for Hog Ranch would be like exchanging Central Park in New York City for an equal acreage of cow pasture.

Another private holding owned by the city is in Till Till Valley. The absurdity of this proposed exchange is demonstrated by the following fact. The special committee of the Commonwealth Club of San Francisco having this very matter under consideration reports that it "is extremely doubtful, considering the difficulties of sanitation" whether Till Till "may be used for the accommodation of visitors" if Hetch-Hetchy becomes a municipal reservoir. Would the nation profit by such an exchange? The very land the nation would acquire could not be used by the public because the land the nation would surrender to the city in exchange would be used as a municipal reservoir, which would be polluted by drainage from Till Till! Till Till would also be rendered practically inaccessible by the flooding of the Hetch-Hetchy camp grounds.

# THE ENDANGERED VALLEY: THE HETCH-HETCHY VALLEY IN THE YOSEMITE NATIONAL PARK.

By John Muir,

Author of "The Mountains of California," "Our National Parks," etc.

The fame of the Merced Yosemite has spread far and wide, while Hetch-Hetchy, the Tuolumne Yosemite, has until recently remained comparatively unknown, notwithstanding it is a wonderfully exact counterpart of the famous valley. As the Merced flows in tranquil beauty through Yosemite, so does the Tuolumne through Hetch-Hetchy. The floor of Yosemite is about 4,000 feet above the sea, and that of Hetch-Hetchy about 3,700, while in both the walls are of gray granite, very high, and rise precipitously out of flowery gardens and groves. Furthermore, the two wonderful valleys occupy the same relative positions on the flank of the Sierra, were formed by the same forces in the same kind of granite, and have similar waterfalls, sculpture, and vegetation. Hetch-Hetchy lies in a northwesterly direction from Yosemite at a distance of about eighteen miles, and is now easily accessible by a trail and wagon-road from the Big Oak Flat road at Sequoia.

The most strikingly picturesque rock in the valley is a majestic pyramid over 2,000 feet in height which is called by the Indians "Kolana." It is the outermost of a group like the Cathedral Rocks of Yosemite and occupies the same relative position on the south wall. Facing Kolana on the north side of the valley there is a massive sheer rock like the Yosemite El Capitan about 1,900 feet high, and over its brow flows a stream that makes the most beautiful fall I have ever seen. The Indian name for it is "Tueeulala." From the edge of the cliff it is perfectly free in the air for a thousand feet, then breaks up into a ragged sheet of cascades among the boulders of an earthquake talus. It is in all its glory in June, when the snow is melting fast, but fades and vanishes toward the end of summer. The only fall I know with which it may fairly be compared is the Yosemite Bridal Veil; but it excels even that favorite fall both in height and fineness of fairy airy beauty and behavior. Lowlanders are apt to suppose that mountain streams in their wild career over cliffs lose control of themselves and tumble in a noisy chaos of mist and spray. On the contrary, on no part of their travels are they more harmonious and self-controlled. Imagine yourself in Hetch-Hetchy on a sunny day in June, standing waist-deep in grass and flowers (as I have oftentimes stood), while the great pines sway dreamily with scarce perceptible motion. Looking northward across the valley you see a plain gray granite cliff rising abruptly out of the gardens and groves to a height of 1,800 feet, and in front of it Tueeulala's silvery scarf burning with irised sun-fire in every fiber. Approaching the brink of the rock, her waters flow swiftly, and in the first white outburst of the stream at the head of the fall there is abundance of visible energy, but it is speedily hushed and concealed in divine repose; and its tranquil progress to the base of the cliff is like that of downy feathers in a still room. Now observe the fineness and marvelous distinctness of the various sun-illumined fabrics into which the water is woven: they sift and float from form to form down the face of that grand gray rock in so leisurely and unconfused a manner that you can examine their texture, and patterns, and tones

 *Read carefully pp. 20-21 and help to save the Park.*

of color as you would a piece of embroidery held in the hand. Near the head of the fall you see groups of booming comet-like masses, their solid white heads separate, their tails like combed silk interlacing among delicate shadows, ever forming and dissolving, worn out by friction in their rush through the air. Most of these vanish a few hundred feet below the summit, changing to the varied forms of cloudlike drapery. Near the bottom the width of the fall has increased from about twenty-five to a hundred feet, and is composed of yet finer tissue, fold over fold—air, water, and sunbeams woven into irised robes that spirits might wear.

So fine a fall might well seem sufficient to glorify any valley; but here as in Yosemite Nature seems in no wise moderate, for a short distance to the eastward of Tueeulala booms and thunders the great Hetch-Hetchy fall, Wapama, so near that you have both of them in full view from the same standpoint. It is the counterpart of the Yosemite Fall, but has a much greater volume of water, is about 1,700 feet in height, and appears to be nearly vertical though considerably inclined, and is dashed into huge outbounding bosses of foam on the projecting shelves and knobs of its jagged gorge. No two falls could be more unlike—Tueeulala out in the open sunshine descending like thistledown, chanting soft and low like a summer breeze in the pines; Wapama in a jagged shadowy gorge roaring and thundering, pounding its way with the weight and energy of an avalanche. Tueeulala whispers that the Almighty dwells in peace; Wapama is the thunder of His chariot-wheels in power. Besides this glorious pair there is a broad massive fall on the main river a short distance above the head of the valley. Its position is something like that of the Vernal in Yosemite, and its roar as it plunges into a surging trout-pool may be heard a long way, though it is only about twenty feet high. There is also a chain of magnificent cascades at the head of the valley on a stream that comes in from the northeast, mostly silvery plumes, like the one between the Vernal and Nevada falls of Yosemite, half-sliding, half-leaping on bare glacier-polished granite, covered with crisp clashing spray into which the sunbeams pour with glorious effect. Others shoot edgewise, through deep, narrow gorges, chafing and surging beneath rainbows in endless variety of form and tone. And besides all these here and there small streams, seldom noticed, come dancing down from crag to crag with birdlike song and watering many a hidden cliff-garden and fernery, doing what they can in the grand general harmony.

The floor of the valley is about three and a half miles long, half a mile wide, and is partly separated by a bar of glacier-polished granite across which the river breaks in rapids. The lower part is mostly a grassy, flowery meadow, with the trees confined to the sides and the river-banks. The upper forested part is charmingly diversified with groves of the large and picturesque California live-oak, and the noble yellow pine, which here attains a height of more than two hundred feet, growing well apart in small groves or singly, allowing each tree to be seen in all its beauty and grandeur. Beneath them the common pteris spreads a sumptuous carpet, tufted here and there with ceanothus and manzanita bushes, azalea and brier-rose, and brightened with Mariposa tulips, goldenrod, tall mints, larkspurs, geraniums, etc., amid

which butterflies, bees, and humming-birds find rich pasturage. Near the walls, especially on the earthquake tali that occur in many places, the pines and California oak give place to the mountain live-oak, which forms the shadiest and most extensive groves. The glossy foliage, densely crowded, makes a beautiful ceiling, with only a few irregular openings for the admission of sunbeams, while the pale-gray trunks and the branches, gnarled and outspread in wide interlacing arches, are most impressively beautiful and picturesque. The sugar-pine, Sabine pine, incense cedar, silver fir, and tumion, occur here and there among the oaks and yellow pines, or in cool side cañons, or scattered on the rifted wall rocks and benches. The river-bank trees are chiefly libocedrus, poplar, willow, alder, and flowering dogwood.

Hetch-Hetchy Valley is a grand landscape garden, one of Nature's rarest and most precious mountain mansions. As in Yosemite, the sublime rocks of its walls seem to the nature-lover to glow with life, whether leaning back in repose or standing erect in thoughtful attitudes giving welcome to storms and calms alike. And how softly these mountain rocks are adorned, and how fine and reassuring the company they keep—their brows in the sky, their feet set in groves and gay emerald meadows, a thousand flowers leaning confidingly against their adamantine bosses, while birds, bees, and butterflies help the river and waterfalls to stir all the air into music—things frail and fleeting and types of permanence meeting here and blending, as if into this glorious mountain temple Nature had gathered her choicest treasures, whether great or small, to draw her lovers into close confiding communion with her.

Hetch-Hetchy weather is delightful and invigorating all the year. Snow seldom lies long on the floor, and is never very deep. On the sunny north wall many a sheltered nook may be found embraced by sun-warmed rock-bosses in which flowers bloom every month of the year. Even on the shaded south side of the valley the frost is never severe.

The most delightful and wonderful campgrounds in the park are the three great valleys—Yosemite, Hetch-Hetchy, and Upper Tuolumne; and they are also the most important places with reference to their positions relative to the other great feaures—the Merced and Tuolumne cañons, and the High Sierra peaks and glaciers, etc., at the head of the rivers. The main part of the Tuolumne Valley is a beautiful spacious flowery lawn four or five miles long, surrounded by magnificent snowy mountains. It is about 8,500 feet above the sea, and forms the grand central High Sierra campground from which excursions are made to the noble mountains, domes, glaciers, etc.; across the range to the Mono Lake and volcanoes; and down the Tuolumne Cañon to Hetch-Hetchy. But should Hetch-Hetchy be submerged, as proposed, not only would it be made utterly inaccessible, but the sublime cañon way to the heart of the High Sierra would be hopelessly blocked.

That any one would try to destroy such a place seemed impossible, but sad experience shows that there are people good enough and bad enough for anything. The proponents of the dam scheme bring forward a lot of bad arguments to prove that the only righteous thing for Hetch-Hetchy is its destruction. These arguments are curiously

like those of the devil devised for the destruction of the first garden—so much of the very best Eden fruit going to waste, so much of the best Tuolumne water. In these ravaging money-mad days monopolizing San Francisco capitalists are now doing their best to destroy the Yosemite Park, the most wonderful of all our great mountain national parks. Beginning on the Tuolumne side, they are trying with a lot of sinful ingenuity to get the Government's permission to dam and destroy the Hetch-Hetchy Valley for a reservoir, simply that comparatively private gain may be made out of universal public loss. This use of the valley, so destructive and foreign to its proper park use, has long been planned and prayed for, and is still being prayed for by the San Francisco board of supervisors, not because water as pure and abundant cannot be got from adjacent sources outside the park,—for it can,—but seemingly only because of the comparative cheapness of the dam required.

Garden- and park-making goes on everywhere with civilization, for everybody needs beauty as well as bread, places to play in and pray in, where Nature may heal and cheer and give strength to body and soul.

It is impossible to overestimate the value of wild mountains and mountain temples. They are the greatest of our natural resources, God's best gifts, but none, however high and holy, is beyond reach of the spoiler.

These temple destroyers, devotees of ravaging commercialism, seem to have a perfect contempt for Nature, and instead of lifting their eyes to the mountains, lift them to dams and town skyscrapers.

Dam Hetch-Hetchy! As well dam for water-tanks the people's cathedrals and churches, for no holier temple has ever been consecrated by the heart of man.

Excepting only Yosemite, Hetch-Hetchy is the most attractive and wonderful valley within the bounds of the great Yosemite National Park and the best of all the campgrounds. People are now flocking to it in ever-increasing numbers for health and recreation of body and mind. Though the walls are less sublime in height than those of Yosemite, its groves, gardens, and broad spacious meadows are more beautiful and picturesque. It is many years since sheep and cattle were pastured in it, and the vegetation now shows scarce a trace of their ravages. Last year in October I visited the valley with Mr. William Keith, the artist. He wandered about from view to view, enchanted, made thirty-eight sketches, and enthusiastically declared that in varied picturesque beauty Hetch-Hetchy greatly surpassed Yosemite. It is one of God's best gifts, and ought to be faithfully guarded.

[NOTE.—The substance of the foregoing article has appeared in the *Century Magazine*, *Sierra Club Bulletin*, and the *Outlook*, and it was written many years before this Hetch-Hetchy question arose.]

. . . . **If a municipal water-works is permitted to erect its plant in the Hetch-Hetchy Valley, it means that the Yosemite Park will become the back-yard of a great municipal utility instead of a recreation ground for all the people of the country.**—Editorial in N. Y. "Outlook," January 30, 1909.

## WHAT THE PRESS THINKS.

### SAVING THE YOSEMITE PARK.

"Before the damage is irremediably done we hope that Congress will investigate the entire Hetch-Hetchy controversy for the express purpose of authoritatively finding out whether San Francisco cannot be adequately supplied with water from some other source. We urge our readers to write to their Representatives in Congress asking for Congressional action."—Editorial in N. Y. *Outlook*, January 30, 1909.

"There is cause for national congratulation in the fact that President Taft, while visiting the Yosemite Valley last week, was accompanied by John Muir, who thus had abundant opportunity to talk to him about San Francisco's proposed conversion of the Hetch-Hetchy Valley into a water tank . . . . . the next Congress will be asked to take away this superb valley from the nation and make a present of it to the city, which, as eminent engineers have shown, does not need it, as it has thirteen other available sources of good water. The grant, if made, would exclude campers and sightseers not only from the Hetch-Hetchy, but from practically one-half of the national park."—Editorial in N. Y. *Nation*, October 14, 1909.

"It behooves all nature-lovers to join Mr. Muir in his efforts to save this temple."—Editorial in N. Y. *Post*, October 12, 1909.

### SHALL THE YOSEMITE BE DESPOILED?

"Aside from the fact that the precedent involved endangers the perpetuity of national parks generally, this is really the first step toward the diversion from public to domestic use of what constitutes scenically more than one-half of the Yosemite National Park. It is time for public-spirited men to insist upon an exhaustive Congressional investigation of the ultimate issues involved in this grant. National parks should be inviolate against every claim except that of absolute public necessity."—Editorial in N. Y. *Independent*, January 14, 1909.

### TO MAINTAIN THE WONDERS OF NATURE.

". . . . A temporary agreement has been reached in Congress not to pass any legislation permanently granting a part of Yosemite National Park—the Hetch-Hetchy Valley—to San Francisco for a source of water supply for a year. This practically nullifies Secretary Garfield's decision granting the city the right to appropriate the valley . . . ."—Editorial in *World's Work*, April, 1909.

(See also article entitled "San Francisco Against the Nation for the Yosemite," by French Strother in the same issue.)

### HETCH-HETCHY, A VALLEY OF WONDERS NOW THREATENED WITH EXTINCTION.

"Every lover of nature, every one who takes pride in our magnificent system of national parks, should earnestly protest against the threatened desecration."—F. M. Fultz in *The World To-day*, May, 1909.

"There are plenty of other sources of water supply for San Francisco or any other large city. Those same rivers can be stored further down at various points; it is true the cost would be greater. Let us keep these grand wild gardens that God has given to us and to all, for all ages to come."—*Christian Science Monitor*, January 30, 1909.

### A RICH GRAB.

[Editorial from *The Oregonian*, Portland, December 30, 1908.]

The whole country is interested in the Hetch-Hetchy Valley. It is an important part of the most valuable territory belonging to the American people. It lies in the Yosemite National Park and next to the Yosemite Valley the Hetch-Hetchy Valley is the most beautiful tract in that wonderful region. It belongs to the people and it should forever be preserved to the people as a source of health and pleasure. . . . San Francisco can get plenty of water elsewhere. Her present supply properly developed would furnish her 100,000,000 gallons daily, whereas she uses but 35,000,000 gallons. Moreover, there are other sources available without trenching on the national domain, which would supply all she needed forever. There are few cities in the world so well able to get abundance of good water as San Francisco. Why, then, this eagerness to grab the Hetch-Hetchy Valley and rob the nation of its property? . . . . The Hetch-Hetchy Valley belongs to the people and they ought to be able to keep it.

Ex-President Roosevelt, in speaking of the Yellowstone Park in his last Annual Message to Congress, said: "This, like the Yosemite, is a great wonderland and should be kept as a national playground. In both all wild things should be protected and the scenery kept wholly unmarred."

*Read carefully pp. 20-21 and help to save the Park.*

## A HIGH PRICE TO PAY FOR WATER.

APROPOS OF THE GRANT OF THE HETCH-HETCHY VALLEY TO SAN FRANCISCO FOR A RESERVOIR.

[Editorial in the *Century Magazine*, August, 1908.]

Of this great park reservation, which is as large as the State of Rhode Island, the northern third—for the watershed of the valley even above the Tuolumne Meadows must go with the valley itself—is to be withdrawn from the use of the people of the whole United States and given to the city of San Francisco. This involves a new principle and a dangerous precedent, and is a tremendous price for the nation to pay for San Francisco's water, and the burden of proof that it is *necessary* is upon those who advocated the grant. It is not enough that it should be thought merely *desirable.*

[Editorial in the *Boston Transcript*, November 28, 1908.]

The case is of interest to the country because it so vitally affects one of the principal national parks and because of its connection with the conservation of natural resources agitation. It is very generally supposed that national parks were established for the purpose of preserving in a natural state some of the chief scenic features of our country, and that once a park had been established it is for all time safe from any attack. Few ever suspected that it lay in the power of any cabinet officer to make a present of a slice of one of these national properties to some favored city. Such is the case, however, and if these parks are to be in fact held sacred in the future the laws governing them must be amended. If the people believe that these lands should be set aside for the preservation of their scenic charms and to furnish recreation grounds for the public amid these uplifting surroundings, then it is time for the individual citizen to bestir himself and as an individual and through organizations apprise the members of Congress of this belief.

[Editorial in *Out West Magazine.*]

If there is anything in the world which should enlist the untiring effort of every true Californian, it is the preservation of our Yosemites. . . .

The very thing that makes the Yosemites glorious to every traveler that sees them, naturally appeals to the corporation hunting for a reservoir. It is perhaps not curious that God Almighty knows as much as our civil engineers know. A reservoir which should fill the Yosemite would be adequate to give all the baths, and all the fresh water drinks taken and to be taken by all the grafters and all the decent persons in San Francisco. But nobody will ever dam the well-known Yosemite. If we permit anybody to dam the Hetch-Hetchy, may we be able to die before our children and grand-children rise up to tell us to our face what vandals and scrubs we were.

The whole thing is absolutely wanton. Out of this tremendous and alpine watershed there is no trouble as to the supplying of all the Golden State without a single vandalism or destroying something which belongs to the whole world. The more we of California can realize that our big trees, our Yosemites, our climate, belong to the world as long as there shall be one, the better we shall do for ourselves and for our children.

A city must have water. There is no question about that. . . . There is always a way to get water. We have had a similar example in the case of Niagara Falls. It is a question whether Buffalo, New York, can peddle the falls out to manufacturers and kill them off for the whole world. The overwhelming sentiment, not only of the foreign world but of America, has been that the falls must be preserved. The overwhelming sentiment of California and of the world will be that our Yosemites must be preserved. It is simply a question of harnessing this public opinion in time.

The matter is at an acute stage. The dollar-minded people are working for this robbery of a State of its glory and its worth to the world, in order to put water into San Francisco. Anybody American enough ought to object to this sort of infamy.—*Chas. F. Lummis.*

DESTROYING A NATIONAL PARK.

". . . . engineers declare that there are a number of Sierra streams, any one of which could satisfy the city's needs. . . . Many people who appreciate the great natural wonders of this country have petitioned their Representatives at Washington to vote against the measure. . . ."—*Harper's Weekly*, September 4, 1909.

## HOW TO HELP TO PRESERVE THE HETCH-HETCHY VALLEY AND THE YOSEMITE PARK.

1. Write at once to Hon. Richard A. Ballinger, Secretary of the Interior, Washington, D. C., requesting him to revoke the Garfield permit to flood the Hetch-Hetchy Valley.

2. Send a copy of the letter to President William H. Taft.

3. See personally if possible, or write to, the Senators and Congressmen from your State, and as many others as you can reach, requesting them to vigorously oppose any bill having for its object the confirmation of the Garfield permit to flood Hetch-Hetchy Valley, and request them to favor legislation designed to protect our parks from invasion, and particularly to favor improving the Yosemite Park. After December 1, 1909, address them either "Senate Chamber" or "House of Representatives," Washington, D. C.

4. After December 1st write to each member of the Public Lands Committees of both the Senate and the House, Washington, D. C., requesting them to oppose any and all legislation having for its object the destruction of the Hetch-Hetchy Valley and to favor any legislation designed to protect the parks. Write to all if you can, but if you cannot, at least write to the Chairman of each committee. (The names of the members of the committees will be found on the opposite page.)

5. Get as many of your friends as possible to write. Remember! every letter and every protest counts.

6. Interest your newspapers and get them to publish editorials and news items and send copies to your Senators and Representatives.

7. Send the names and addresses of any persons who would be interested in receiving this pamphlet to "Society for the Preservation of National Parks, 302 Mills Building, San Francisco, Cal."

**EDITORS** are respectfully requested to write brief editorials and news items informing the public and calling on them to write to their Congressmen and Senators and protest.

**CLUBS** should send copies of resolutions they may adopt to President Taft, Secretary Ballinger, and each member of the Public Lands Committees, and the Senators and Representatives from their State.

**FUNDS ARE NEEDED** to carry on this fight. A few have generously carried the burden of expense connected with the issuance of this literature, but more money is required to spread information. Those who would like to render pecuniary assistance may send their contributions to JOHN MUIR, President of Society for the Preservation of National Parks, 302 MILLS BUILDING, SAN FRANCISCO, CAL.

### WHERE TO OBTAIN INFORMATION CONCERNING THE PROPOSED UNNECESSARY DESTRUCTION OF THE FINEST HALF OF THE YOSEMITE NATIONAL PARK.


Putnam's Magazine, May, 1909. "Camping Above the Yosemite," by Harriet Monroe, pp. 221-6.
The World To-Day, May, 1909. "The Hetch-Hetchy," by F. M. Fultz, pp. 524-530.
World's Work, April, 1909. Editorial and article entitled, "San Francisco Against the Nation."
Suburban Life, March, 1909. Article entitled "Despoiling the Hetch-Hetchy," by Wm. F. Badè, pp. 117-118.
Outlook (N. Y.) January 30, 1909. Editorial, pp. 234-236; Article entitled "Dismembering Your National Park," by R. U. Johnson, pp. 252-3.
Outlook (N. Y.) February 13, 1909. Editorial, pp. 330-331.
The Independent (N. Y.) May 14, 1908. "The Hetch-Hetchy Valley," pp. 1079-1084.

MEMBERS OF THE PUBLIC LANDS COMMITTEE OF THE SENATE.

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|---|---|
| Hon. John H. Bankhead | Fayette, Ala. |
| " Geo. E. Chamberlain | Portland, Or. |
| " Clarence D. Clark | Evanston, Wyo. |
| " Jefferson Davis | Little Rock, Ark. |
| " Joseph M. Dixon | Missoula, Mont. |
| " Frank P. Flint | Los Angeles, Cal. |
| " Robert J. Gamble | Yankton, So. Dak. |
| " Weldon B. Heyburn | Wallace, Idaho |
| " Martin N. Johnson* | Petersburg, N. Dak. |
| " Wesley J. Jones | No. Yakima, Wash. |
| " Samuel D. McEnery | New Orleans, La. |
| " Knute Nelson (Ch.) | Alexandria, Minn. |
| " Francis G. Newlands | Reno, Nev. |
| " Robert L. Owen | Muskogee, Okla. |
| " Reed Smoot | Provo Utah |

*Deceased

MEMBERS OF PUBLIC LANDS COMMITTEE, HOUSE OF REPRESENTATIVES.

| | |
|---|---|
| Hon. Wm. H. Andrews | Santa Fe, N. M. |
| " Adam M. Byrd | Philadelphia, Miss. |
| " Wm. B. Craig | Selma, Ala. |
| " Chas. A. Crow | Caruthersville, Mo. |
| " Scott Ferris | Lawton, Okla. |
| " Asle J. Gronna | Lakota, No. Dak. |
| " Thos. R. Hamer | St. Anthony, Idaho |
| " Dudley M. Hughes | Danville, Ga. |
| " Eben W. Martin | Deadwood, So. Dak. |
| " F. W. Mondell (Ch.) | Newcastle, Wyo. |
| " Dick T. Morgan | Woodward, Okla. |
| " Herbert Parsons | New York |
| " Chas. E. Pickett | Waterloo, Ia. |
| " Chas. N. Pray | Ft. Benton, Mont. |
| " Geo. W. Rauch | Marion, Ind. |
| " John M. Reynolds | Bedford, Penn. |
| " Joseph T. Robinson | Lonoke, Ark. |
| " Sylvester C. Smith | Bakersfield, Cal. |
| " Edward T. Taylor | Glenwood Spgs., Col. |
| " Andrew J. Volstead | Granite Falls, Minn. |

It is particularly urgent that you impress the members of the Public Lands Committees from your State with the importance of *opposing* any bill granting the Hetch-Hetchy Valley to San Francisco. See them personally if possible, write to them and send resolutions to them. After December 1st address them, "Senate Chamber" or "House of Representatives," Washington, D. C.

HON.....

*House of Representatives or Senate Chamber,* (as the case may be)
Washington, D. C.

SIR:—Our national parks are already too few in number. We are vitally interested in preserving intact those now existing. We earnestly protest against the destruction of any of the wonderful scenery of the Yosemite National Park and urge you to oppose any bill which will permit San Francisco to use Hetch-Hetchy as a municipal water tank. Strengthen our park laws instead of allowing them to be overriden.

Very truly,

.....

(Write letters similar to the foregoing in your own language and in accordance with your own ideas.)

WHEREAS: The Hetch-Hetchy Valley is one of the grandest and most important features of the great Yosemite National Park belonging to the ninety millions of people composing the American public;

WHEREAS: This valley is threatened with destruction by those seeking a water supply for San Francisco and the use of the park by the public would thereby be seriously restricted;

WHEREAS: The precedent thus established would destroy the integrity of our whole national park system;

WHEREAS: The need for great public playgrounds is becoming vastly greater instead of diminishing;

WHEREAS: Eminent engineers report that this proposed invasion of a national wonderland is wholly unnecessary and that San Francisco can get an abundance of pure water elsewhere;

*Now Therefore be it Resolved:* That we are earnestly opposed to such a needless local use of a priceless national possession in which the entire citizenship is interested, and we petition the President and the Secretary of the Interior to revoke the revocable permit now existing and urge all Senators and Representatives, especially those composing the Public Lands Committees, to defeat any bill which proposes to confirm any such invasion; and that a copy of this resolution be sent to the President, the Secretary of the Interior, our representatives in Congress and to the members of the Public Lands Committees.

(Clubs should adopt resolutions similar to the foregoing.)

"The national parks—all too few in number and extent—ought to be held absolutely inviolate, as intended by Congress. Intrusions for questionable water-supply needs, against the unselfish protests of those whose love of country cannot be impugned, should not be permitted."—*J. Horace McFarland.*

## VIEWS OF MEMBERS OF THE COMMITTEE OF PUBLIC LANDS OF THE HOUSE OF REPRESENTATIVES.

"I am of the opinion that the city has failed to establish its contention that the Hetch-Hetchy is the only reasonably available source of water supply in the Sierras, and that, therefore, the interests of the people of all the country should be waived on behalf of San Francisco in its claim to exclusive use of this valley."—*F. W. Mondell, Scott Ferris, W. B. Craig, Jno. M. Reynolds, D. W. Hamilton.*

"We are opposed to this resolution in its present form, as it does not sufficiently guard public interests. We believe that its passage will eventually exclude the public from the Hetch-Hetchy Valley and the Tuolumne Cañon, and we are not willing that that should be done, as it does not appear that it is necessary for the city of San Francisco to obtain this property for a water supply.

"It appears from the testimony given by the committee appointed by the city to urge this resolution before this committee that there are other available supplies in the Sierras."—*A. J. Volstead, A. J. Gronna.*

"The undersigned admits that if this source is essential to San Francisco the grant should be made. But San Francisco has not made out a case showing that it is essential. The testimony indicates that there are a number of other sources. . . .

"San Francisco is in an enviable situation for water supply. It has all the Sierras, with their mountain snows and lakes to draw upon. There are no less than sixteen different systems. . . .

"The fact of the matter is that San Francisco, having its eye on the Hetch-Hetchy, has not thoroughly investigated other systems. . . .

"Certainly the Federal Government is not bound to give up to San Francisco two fifths of a national park simply because it is cheaper. Why is it cheaper? It is cheaper because, having been made a national park, it has not been possible for private interests to file upon the water in the same manner that they could have if there had not been a national park. Had private interests been allowed to file upon the water, San Francisco would not have thought of going to Hetch-Hetchy any more than to any other place. It would have chosen the place that it most cheaply could have condemned. It goes to Hetch-Hetchy mainly because it is cheapest. Hetch-Hetchy is cheapest because it belongs to all the people instead of to some of the people. It has been preserved and made cheap because the purpose was to use it as a national park. Hav-

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**Cincinnati, O. TELEGRAM. Nov. 18, 1909.**

**Resolution passed by the American Civic Association, Thursday, Nov. 18, 1909, recognizing the wisdom of the Congress in setting aside for public use the great national parks and believing that any avoidable interference with the scenic integrity of these parks is in the highest degree undesirable, the American Civic Association in convention assembled urges the Secretary of the Interior to revoke the permit and the Congress to refuse to confirm such permit under which the city of San Francisco is assuming to control eventually for a domestic water supply more than five hundred square miles of the best of the Yosemite National Park, unless after a full and impartial inquiry it shall be shown to the satisfaction of the Congress that no other sufficient source of water supply is available to San Francisco. We further respectfully represent that the granting and confirmation of such a permit to invade the public domain would create a most dangerous precedent under which other scenic possessions of the United States would be unsafe from individual or corporate assault.** **J. HORACE McFARLAND, Pres. RICHARD B. WATROUS, Secy.**

ing been made cheap in that manner, San Francisco now desires to use it for itself by spoiling the very purpose which has made it cheap. . . .

"I believe that we owe it to all the people to preserve Hetch-Hetchy uninterfered with for the use and enjoyment of all the people and to carry out the policy intended when it was included within the boundaries of the Yosemite National Park."—*Herbert Parsons.*

3. The Hetch-Hetchy Valley is a wonderfully exact counterpart of the great Yosemite.

4. The Grand Cañon of the Tuolumne is one of the finest cañons in America with its wonderful cascades and waterfalls and tremendous cliffs and walls.

2. "The upper Tuolumne Valley is the widest, smoothest, most serenely spacious, and in every way the most delightful pleasure park in all the High Sierra."—John Muir.

The shaded portion represents substantially the area of the Tuolumne drainage which would be affected by the Hetch-Hetchy grant.

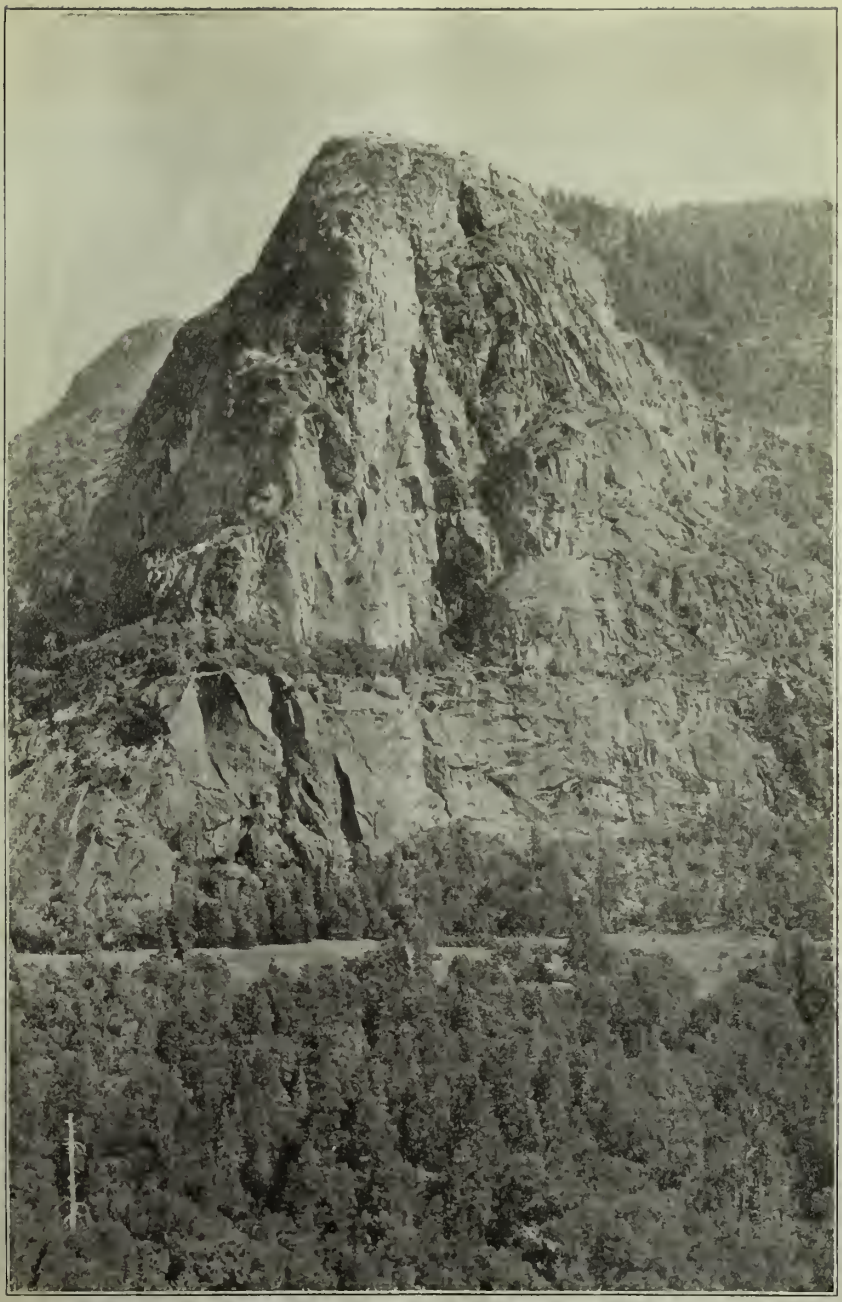
"WE DESCENDED INTO THE [HETCH-HETCHY] VALLEY, AND MARCHED FOR MILES, SINGLE FILE, THROUGH A FAINT TRAIL BETWEEN FLOWERY GRASSES SHOULDER HIGH; MARCHED TO OUR CAMP UNDER THE STRAIGHT GRANITE COLUMN OF KOLANA — A CAMP SHADOWED BY GREAT PINES AND FIRS AND CEDARS, BESIDE THE BEAUTIFUL TUOLUMNE."—*Harriet Monroe.*

Photo by Herbert W. Gleason.

"NO TWO FALLS COULD BE MORE UNLIKE — TUEEULALA OUT IN THE OPEN SUNSHINE DESCENDING LIKE THISTLEDOWN, CHANTING SOFT AND LOW LIKE A SUMMER BREEZE IN THE PINES; WAPAMA IN A JAGGED, SHADOWY GORGE ROARING AND THUNDERING, POUNDING ITS WAY WITH THE WEIGHT AND ENERGY OF AN AVALANCHE."—*John Muir.*

Photo by Herbert W. Gleason.

"IT IS THE COUNTERPART OF THE YOSEMITE FALL, BUT HAS A MUCH GREATER VOLUME OF WATER, IS ABOUT 1,700 FEET IN HEIGHT, AND APPEARS TO BE NEARLY VERTICAL THOUGH CONSIDERABLY INCLINED, AND IS DASHED INTO HUGE OUTBOUNDING BOSSES OF FOAM ON THE PROJECTING SHELVES AND KNOBS OF ITS JAGGED GORGE."—*John Muir.* Photo by Herbert W. Gleason.



"THE MOST STRIKINGLY PICTURESQUE ROCK IN HETCH-HETCHY VALLEY IS A MAJESTIC PYRAMID OVER 2,000 FEET IN HEIGHT WHICH IS CALLED BY THE INDIANS 'KOLANA.' IT IS THE OUTERMOST OF A GROUP LIKE THE CATHEDRAL ROCKS OF YOSEMITE AND OCCUPIES THE SAME RELATIVE POSITION ON THE SOUTH WALL."—*John Muir.* Photo by Herbert W. Gleason.

"HETCH-HETCHY VALLEY IS A GRAND LANDSCAPE GARDEN, ONE OF NATURE'S RAREST AND MOST PRECIOUS MOUNTAIN MANSIONS. AS IN YOSEMITE, THE SUBLIME ROCKS OF ITS WALLS GLOW WITH LIFE, WHETHER LEANING BACK IN REPOSE OR STANDING ERECT IN THOUGHTFUL ATTITUDES GIVING WELCOME TO STORMS AND CALMS ALIKE."—*John Muir.*

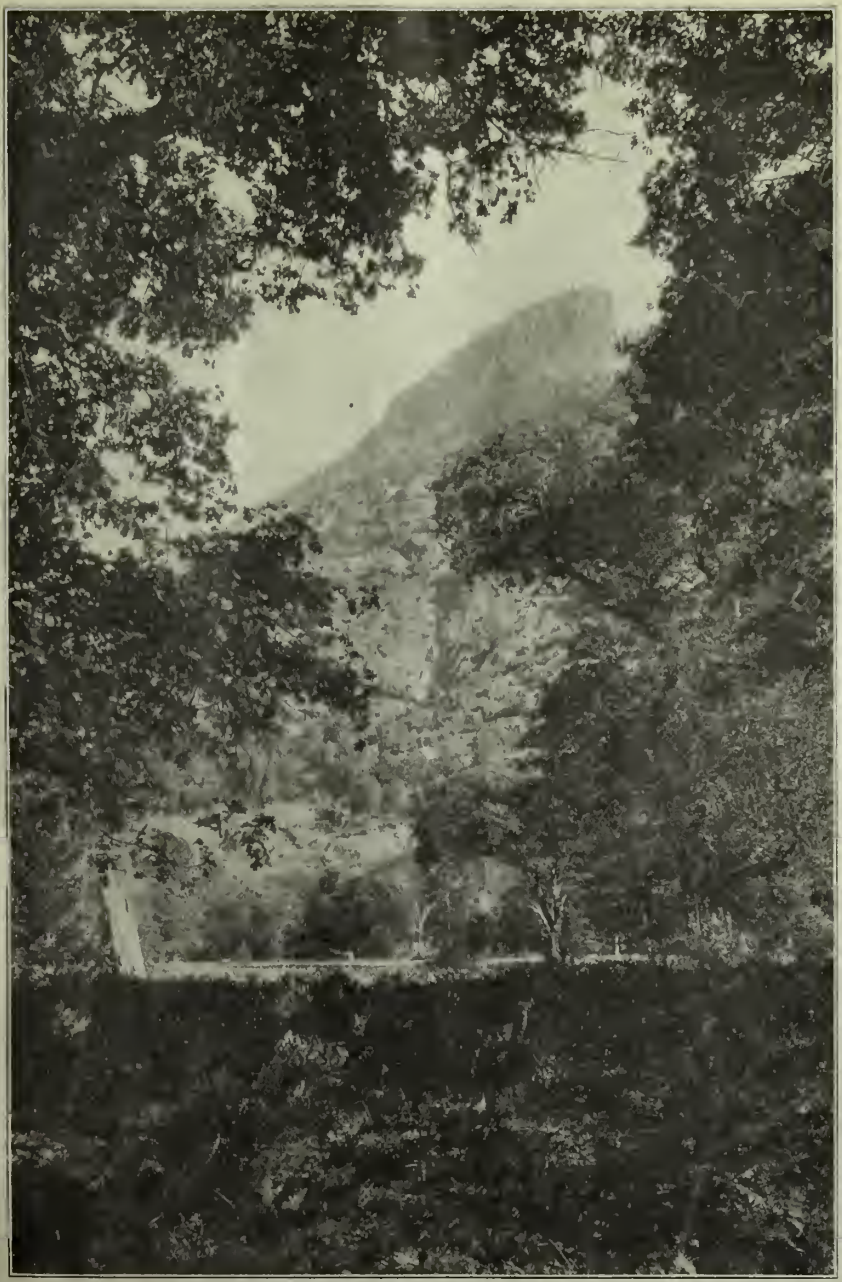
Photo by Herbert W. Gleason.

"FACING KOLANA ON THE NORTH SIDE OF THE VALLEY THERE IS A MASSIVE SHEER ROCK LIKE THE YOSEMITE EL CAPITAN, ABOUT 1,900 FEET HIGH, AND OVER ITS BROW FLOWS A STREAM THAT MAKES THE MOST BEAUTIFUL FALL I HAVE EVER SEEN."—*John Muir.*

Photo by Herbert W. Gleason.

"THE UPPER FORESTED PART IS CHARMINGLY DIVERSIFIED WITH GROVES OF THE LARGE AND PICTURESQUE CALIFORNIA LIVE-OAK, AND THE NOBLE YELLOW PINE, WHICH HERE ATTAINS A HEIGHT OF MORE THAN TWO HUNDRED FEET, GROWING WELL APART IN SMALL GROVES OR SINGLY, ALLOWING EACH TREE TO BE SEEN IN ALL ITS BEAUTY AND GRANDEUR. BENEATH THEM SPREADS A SUMPTUOUS FERN CARPET."—*John Muir.*

Photo by J. N. Le Conte.



"IT WAS A GARDEN OF PARADISE, THIS VALLEY; A LESSER YOSEMITE, BUT VERY DIFFERENT, WITH AN INFINITELY CHARMING INDIVIDUALITY OF ITS OWN; SMALLER BUT MORE COMPACT, LESS GRAND BUT NOT LESS BEAUTIFUL. IN ITS WONDERFUL FOREST GROWTH OF GREAT VARIETY AND MAGNIFICENT DEVELOPMENT IT SURPASSES THE YOSEMITE VALLEY ITSELF."—*Harriet Monroe.*

Photo by J. N. Le Conte.

"HUNDREDS OF FEET BELOW LAY THE VALLEY, A BROAD MEADOW, GREEN AS EMERALD, SKIRTED AT THE EDGE WITH FORESTS AND LOCKED IN PRECIPITOUS GRANITE CLIFFS, MOUNTAIN HIGH, BETWEEN WHICH WHITE WATERFALLS STOOD ERECT AND SLIM LIKE DRYADS."—*Harriet Monroe.* Photo by J. F. Kinman.

THE FACTS ABOUT

# The Bay Cities Water Company's

WATER SUPPLY FOR SAN FRANCISCO

AN ADDRESS BEFORE THE

## COMMONWEALTH CLUB

ON MARCH 13, 1907

—BY—

EDWIN DURYEA, Jr., *M. Am. Soc. C. E.*

CHIEF ENGINEER OF THE COMPANY

—ALSO—

A COMPLETE AND EXACT COPY

—OF THE—

PROPOSITION MADE BY THE BAY CITIES WATER COMPANY TO THE BOARD OF SUPERVISORS

ON APRIL 9 AND MAY 21, 1906

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An Address Before the COMMONWEALTH CLUB on March 13, 1907, by Edwin Duryea, Jr., M. Am. Soc. C. E., Chief Engineer of the Company.

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COMMONWEALTH CLUB

## DISCUSSION ON WATER-SUPPLY OF SAN FRANCISCO.

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THE FACTS ABOUT THE BAY CITIES WATER COMPANY'S PROJECT,

*by* Edwin Duryea, Jr., M. Am. Soc. C. E.,
Chief Engineer of the Company.

March 13, 1907.

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I have been invited by the Club to present the facts about the Bay Cities Water Company's project of a water-supply for San Francisco and shall therefore say but little on other phases of the subject. The need of San Francisco for a larger and better water-supply than it now has, and for municipal ownership of its supply, seems so self-evident as to be hardly worth discussion. It seems equally evident that the new supply should be from the Sierras—and the only debatable question is which one of the several Sierra supplies will best meet the needs of San Francisco.

Of the various Sierra supplies, but two are prominently mentioned at present as water-supplies for San Francisco. These two are the Tuolumne supply, advocated by Mr. James D. Phelan, former Mayor of San Francisco, and the American-Cosumnes supply, owned by the Bay Cities Water Company.

But brief comments will be made on the Tuolumne supply, (1) to show the improbability of San Francisco being able to acquire it and (2) to correct two of the misstatements made by Mr. Phelan in regard to it, both in his present discussion and previously in newspapers. As to its acquirement, it should not be forgotten that no matter what the merit of the Tuolumne as a source of water-supply for San Francisco (and I believe it to have much merit), the United States Government has several times refused San Francisco permission to use it for that

purpose. Such a permission would be not only contrary to the established policy of the Government, but in direct disregard of the protests of agriculturists in the valley below, dependent on irrigation. The Government doubtless realizes that its adverse decision entails no more serious consequence to San Francisco than the necessity of adopting some other of the several Sierra supplies, as good as the Tuolumne but perhaps a little more costly. Should any reservoir privileges be granted, the Modesto-Turlock Irrigation District, served by water from the Tuolumne, would be the interest most likely to receive them. Large sums have been spent in perfecting this irrigation system, which cannot, as can San Francisco, use other streams than the Tuolumne. The District has already, I believe, applied to the National Government for reservoir privileges on the Tuolumne.

To all except ardent partisans of the Tuolumne supply, its acquirement by San Francisco seems impracticable and still as far distant as when the effort to acquire it was begun, about six years ago.

The misstatements of Mr. Phelan which will be corrected are as follows:

First, he states that the area contributing to the Tuolumne supply contains "more than 1500 square miles," though the fact is that the combined catchment-area of the Lake Eleanor and Hetch Hetchy reservoirs contains but 530 square miles. (See Report of C. E. Grunsky, City Engineer, Municipal Reports, San Francisco, 1902-03, pp. 414 and 416). The misstatement probably arose from confusing the area above the Government Gaging Station at La Grange, 1501 square miles, with the area above the point where the San Francisco supply would leave the river, many miles further up-stream. The correction of this misstatement shows the true water-producing area of the "Tuolumne Supply" to be only 30 per cent. of that claimed by Mr. Phelan.

The other misstatement relates to the run-off or stream-flow of the Tuolumne. Mr. Phelan states that the Tuolumne catchment-area has a "mean annual rainfall of from 20-50 inches" and a "mean annual run-off of 24 inches." Mr. Grunsky states (see his Report, pp. 420 and 423, S. F. Munic. Rep., 1902-03) that both the Lake Eleanor and the Hetch Hetchy catchment-areas have average mean annual rainfalls of about 36 inches, with a mean annual run-off of about 14 inches. He also says "the minimum (rainfall) may be as low as 18 inches per annum" and "for a season of minimum precipitation, when the fall of rain and snow throughout the watershed may be equivalent to only 18 inches of rain, it is estimated that the run-off would be about 5.4 inches." The date of Mr. Grunsky's report was July, 1902. Later studies by him, embodied in an official drawing dated February, 1904, show that his final conclusion is that with Sierra conditions an 18-inch rainfall cannot be safely depended upon to yield more than 3.4 inches of run-off. I may add that I have discussed this drawing (entitled *Revised* Run-off Curves) with him verbally and was told that it embodied his latest and most reliable data of run-off, and should be used in preference to any of his earlier conclusions.

Instead, therefore, of an average annual run-off of 24 inches from the Tuolumne area, as claimed by Mr. Phelan, Mr. Grunsky claims only 14 inches, or only 58 per cent. as much. The *average* run-off has

but little bearing on water-supply, however, as for that purpose only the worst conditions, or the minimum run-off, can be considered. According to Mr. Grunsky's conclusions the value of the Tuolumne for water-supply is represented by 5.4 inches run-off (in his report of 1902), or more accurately by 3.4 inches (in his Revised Run-off Curve of 1904). These values are respectively 23 per cent. and 14 per cent. of the 24 inches average run-off mentioned by Mr. Phelan.

If the above error in run-off is combined with the error in area, the product of the 14 per cent. by the 36 per cent. gives about 5 per cent. as the relation between the actual water-producing value of the Tuolumne and that corresponding to the area and the average run-off mentioned by Mr. Phelan. It is to be regretted that both Mr. Phelan and his engineering coadjutor, Mr. Manson, were ignorant of these errors, since their effect has been to make the water-supply of the Tuolumne appear to the public (which knows nothing of the distinction between average and minimum run-off) about twenty times as great as is really the fact. Even comparing average years, Mr. Phelan's statement of 24 inches run-off from 1500 square miles and Mr. Grunsky's claim of only 14 inches from 536 square miles make the water-production of the Tuolumne supply in average years about five times as great, according to Mr. Phelan, as claimed by Mr. Grunsky.

Before leaving this brief consideration of the Tuolumne, it will be of interest to compare its water-producing capability with that of the American-Cosumnes area of the Bay Cities Water Company.

The latter area comprises 396 square miles of Sierra territory, on the South Fork of the American River and the North Fork of the Cosumnes River. It has mean annual rainfalls varying in different parts from 45 inches to over 70 inches, the average for the whole area of 396 square miles being 59.7 inches. These mean rainfalls are from the map of the California Water and Forest Association, 1900, Marsden Manson, C. E., used in conjunction with all available subsequent information. The final result of 59.7 inches mean annual rainfall is reliable, being confirmed, among other local data, by rainfall observations of from one to six years duration at eight stations within the catchment-area.

It is worthy of mention that the rainfall lines of the Water and Forest Association Map give a mean annual rainfall of 49.3 inches for the Tuolumne area. However, as Mr. Grunsky's report of 1902 was written two years after the publication of that map and with a full knowledge of it, it may be presumed that he doubted the correctness of its rainfall lines over the Tuolumne area. His statement of the mean annual rainfall of the Tuolumne, 36 inches, will be used in the comparison.

The comparison can best be shown by tabulation, as below. The sources of most of the data have already been mentioned—being Mr. Grunsky's Report of 1902, his Revised Run-off Curves of 1904, the Water and Forest Association Map of 1900, U. S. Government Contour-

maps, etc., etc. The minimum annual rainfall (snow included) is taken as half of the mean, as was done by Mr. Grunsky for the Tuolumne.

| ITEM | TUOLUMNE | AMERICAN-COSUMNES |
|---|---|---|
| Catchment Area | 536 sq. miles=100% | 396 sq. miles = 74% |
| Mean Annual Rainfalls vary from | 20 ins.-50 ins. | 45 ins. - over 70 ins. |
| Average Mean Annual Rainfall | 36 ins. =100% | 59.7 ins. = 166% |
| " Minimum " " ($\frac{1}{2}$) | 18 ins. =100% | 29.8 ins. = 166% |
| Mean Annual Run-off (Average) | 14.0 ins. =100% | 32.0 ins. = 229% |
| Minimum " " ( " ) | 3.4 ins. =100% | 9.9 ins. = 291% |
| Catch. Area x Av. Mean Run-off- | 100% x 100% =100% | 74% x 229% = 168% |
| " x " Min. " = | 100% x 100% =100% | 74% x 291% = 215% |

It is thus seen that the dependable stream-flow or water-producing capability of the Bay Cities Water Company's Catchment-area is in average years over one and two-thirds times as great as that of the Tuolumne, while in years of least rainfall (the only ones to be seriously considered in relation to water-supply) it is more than twice as great.

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A brief consideration of the American-Cosumnes Project of the Bay Cities Water Company will now be made on its own merits, regardless of other sources of supply.

In considering the advisability of acquiring a system of City water-supply, the questions which arise are physical, legal and financial and may be formulated somewhat as follows:

(1) Will the system furnish, and continue to furnish, an ample and reliable supply of pure water?

(2) If physically satisfactory, can valid rights to the water and the system be acquired by the city?

(3) If physically desirable and legally acquirable, will the benefits secured by the purchase be commensurate with its cost to the city?

My investigations as engineer of the Bay Cities Water Company have dealt with the first of these questions. The second can be answered conclusively only by lawyers. I shall say nothing regarding it except that this question was investigated by competent lawyers before the Bay Cities Water Company acquired any rights in the American-Cosumnes Project, and the Company was advised that its contemplated investment could safely be made and that the use of these waters for a San Francisco supply could give rise to no serious legal objections, provided the contracts for supplying water which are yet unexpired be carried out; and that the Company is under no obligation to renew such contracts when they expire. There will be no necessity of ceasing to

serve the present users of the water, however, as the Bay Cities Water Company controls other water-properties, not available in connection with its proposed San Francisco supply, which are ample for these needs. The third question—the relation between benefit and cost—rests for its final decision with the voters of San Francisco. I shall, however, give a few facts which may aid in the decision.

As to the physical facts of the American-Cosumnes Project I am able to speak with full authority, having spent in engineering studies of the project not only about a year net of my own time, but nearly two years time of a large, expensive and efficient engineering department. It was realized in the beginning that the full facts could be obtained only by patient, honest and long-continued engineering surveys and investigations and that such work is necessarily costly; and while all money was expended with care, the cost of obtaining the necessary data was never allowed to prevent its acquirement. The cost to San Francisco of its investigation of the Tuolumne supply is said to have been $40,000. The Bay Cities Water Company has already expended a still larger sum in the engineering investigation of its American-Cosumnes Project—and has secured data for use in connection either with city water-supply or the development of hydraulic power well worth its great cost.

The chief physical facts to be learned about a new water supply are (1) as to the purity of the water and the probability of its so continuing; (2) the amounts of rainfall and stream-flow which may be depended on in the worst years, with their distributions; and (3) the number, distribution and individual and aggregate capacities of the various practicable reservoir-sites within the catchment-area. The results of my engineering investigations of the Bay Cities Water Company's project will be given very briefly under these headings.

The first consideration in a water-supply is the purity of its water. Conclusive proof has been obtained of the purity of the American-Cosumnes supply by analyses of samples of the water from Silver Lake, Echo Lake, the American River at the head of the Canal and the Cosumnes River at Buck's Bar. These samples were taken in the fall of 1905, when the water in the streams was at its lowest stage and the number of campers greatest. The report of the chemists (Thomas Price and Son) shows all the samples to be of unusual purity—even that from Buck's Bar, the lowest point on the catchment-area and the only one with the remotest probability of contamination. Quoting from their report, "The foregoing analyses show these waters to possess a degree of purity which is not equalled by that supplied to any large city in the world."

This conclusion could be confidently expected, as unprejudiced engineers know the water from all Sierra sources to be of unusual purity except where contaminated by mining camps, wastes from mines, and human habitations. There are no mines (and no permanent population of any kind) on the 238 square miles of American River territory, while on the 158 square miles of Cosumnes territory there are no operating mines and only one mine, with 15 men employed, doing prospecting work. The mining activity in all this region has been decreasing for years past, as has the population within the Cosumnes catch-

ment-area. Neither is there any likelihood of a revival of the mining (never of any magnitude), as the Mariposa slates of the Mother Lode do not extend so far eastward and the small amount of hydraulic mining done in earlier years is now permanently discouraged by the debris laws.

Whether shown pure by analysis or not, the uninterrupted safety of any catchment-area for purposes of city water-supply may be judged relatively by its number of inhabitants. Catchment-areas with large populations can be so inspected and regulated as to make their water entirely safe for city use (the water-supply of New York, a very healthy city, is now furnished from a catchment-area having 10,000 population); but on the other hand, a slack inspection or regulation of populated areas may lead to serious epidemics, while very sparsely inhabited or uninhabited areas are beyond suspicion and practically beyond need of inspection or regulation.

The catchment-areas of the Bay Cities Water Company are practically uninhabited. From careful estimates of population, made independently by different people and agreeing closely with each other and with County records, it is known that the American River Catchment-area has absolutely no permanent inhabitants except three ditch-tenders and their families, while its population during the summer months (including guests at hotels but not including campers) is only about 65 on its area of 238 square miles. During the summer months the population of the Consumnes Catchment-area is only about 305 (including guests at hotels but not including campers). During the winter its population is still less. Of these 305, about 100 are at Grizzly Flat and 120 at Pleasant Valley. Neither Grizzly Flat nor Pleasant Valley territory need be included within the catchment-area utilized for a San Francisco supply for many years to come, and when they are included the Pleasant Valley population will be almost entirely wiped out by a reservoir which should be located on the site of the slowly dying village, while Grizzly Flat will be about ten miles from the next reservoir below.

As to the summer campers, their number is not great and is certainly negligible in comparison with the large and constantly increasing number of tourists who visit the Tuolumne each summer.

To conclude these few remarks as to the purity of the American-Cosumnes water and the freedom of its catchment-area from contaminating influences, chemical analyses show the water to be pure at present; the population is less than one per square mile during even the summer months and this population is decreasing; and the recent extension of the forest-reserve limits to cover 249 square miles of the catchment-area will tend to still further decrease its use for human habitations.

The investigations under the second heading—Amounts of Rainfall and Stream Flow—made use of all published data, also of all other data that could be secured. The published data consists mainly of records of rainfall and stream-flow of Sierra territory for years past, as contained in the publications of the U. S. Weather Bureau and the U. S. Geological Survey. Among the unpublished data are records of rainfall and stream-flow taken with great care by the Standard Electric Company and worked up under my own direction by the engineer in charge of the observations; also rainfall and stream-flow measurements

taken by my own assistants, these observations being still in progress. The published rainfall data which appeared doubtful was carefully examined into. In one intsance (Shingle Springs) the original record, kept by an English physician, was hunted down by tracing the movements of a son of the observer until he was found in Sacramento and from him obtaining the original record-book kept by his father, showing the rainfall at Shingle Springs for 1849 and many years thereafter.

The physical data collected under my own direction consists not only of rainfall, snow-fall and stream-flow observations on the catchment-area, but also of surveys of twenty-four separate reservoir-sites and dam-sites, and of canal locations and tunnel locations. These surveys were begun in the fall of 1905 and continued and completed, by four survey parties, in the summer and fall of 1906.

Data only has so far been referred to. Such data is absolutely essential to the careful investigation of a water-supply, but it is only preliminary to the real investigation and no more important than the subsequent working out of the problem. The latter is indeed much the higher class of engineering work. It is a popular error to look on surveying as synonymous with civil engineering. This idea is entirely erroneous, surveying being merely a means of collecting a certain class of data for the use of civil engineers. The real engineering consists in making use of such data, by proper methods, to form definite and reliable conclusions. While much time and great cost has been expended by the Bay Cities Water Company in acquiring data in the field, still more time and cost has been expended in carefully and conscientiously working up such data in the office. It cannot be expected that a two years' investigation will be described in a few minutes in a short paper, therefore I will close the consideration of the amount of water which can be supplied for City use by a proper development of the American-Cosumnes Catchment-area by giving a list of the results of the investigation, without further comment than to say that all results were worked out with great care and with an honest effort to ascertain the truth without favor to the Bay Cities Water Company.

The reservoir surveys show that an aggregate water-storage of 104,900 million gallons may be secured in eighteen reservoirs. These reservoirs are all practicable and can be created by dams of practicable height and cost. Six other reservoir sites were surveyed, but were rejected because their capacity was too small to justify the cost of their dams.

The investigation shows that by the combined use of the stream-flow and above reservoir storage, a continuous and dependable water-supply of over 317 million gallons per day can be furnished throughout the dryest year known. It also shows that 198 million gallons of this total would be furnished by the fully developed American River area alone, or 215 million gallons if the Sly Park area of the Cosumnes is added; and 119 million gallons by the developed Cosumnes area. Also that the combined American-Cosumnes area, excluding only Pleasant Valley and Buck's Bar reservoirs and their tributary areas, can be depended upon to furnish a continuous daily supply of 242 million gallons throughout the dryest years.

From an extension of Professor Marx' estimate, San Francisco will require a daily water-supply of 317 million gallons in about 1975, or say 70 years in the future. From an extension of a published estimate by Mr. Schussler, this amount of water will not be required until about 2030, or until say 120 years hence. Professor Marx' and Mr. Schussler's estimates of future population, extended, show a population of 3,000,000 people in the years 1995 and 2040 respectively; and this population, at a per capita consumption of 100 gallons per day (much more than now used) would nearly exhaust the 317 million gallons daily supply. It therefore appears that should San Francisco acquire the American-Cosumnes project of the Bay Cities Water Company, she would not (even if her present supply be left out of consideration) find it necessary to seek an additional source of supply for at least 70 years to come and perhaps not for more than 100 years.

The final consideration mentioned—what San Francisco will get in return for its cost should she purchase the American-Cosumnes Project of the Bay Cities Water Company—will now be treated briefly. To begin with, her purchase will give her the water-rights, many of them in use for more than thirty years past, on 396 square miles of Sierra territory having a high rainfall and stream-flow, and 249 square miles of which are now within the U. S. Forest Reserve. These water-rights include property or flowage-rights to numerous reservoir-sites as well as the right of diversion from the streams, and give the city control of all natural features necessary for the development and control of a water-supply with an ultimate capacity of 317 million gallons per day throughout the dryest years. Also, incidentally, a water-power development is practicable of over 50,000 Theoretical, or over 30,000 Salable Horse Power.

In addition to the property and flowage-rights and the undeveloped water-supply resources which San Francisco would secure, she would at once become possessed of a developed catchment-area capable of furnishing over 88 million gallons per day of water at the head of a pipe-line leading to San Francisco, and of furnishing over 16,000 Theoretical, or over 10,000 Salable, Horse Power from the water. The completed structures necessary to this water-development and in which she would at once acquire property rights would be briefly as follows:

FIRST. An existing dam at Silver Lake impounding 1950 million gallons.

SECOND. An existing dam at Echo Lakes, impounding 700 million gallons, with a short flume and tunnel to conduct water from the Lakes into the head waters of the American River.

THIRD. An existing dam impounding 800 million gallons of water in the Medleys reservoir.

FOURTH. A concrete-steel diversion dam 34 feet high on the South Fork of the American River at Slippery Ford, to divert water from the stream-bed into the American Canal.

FIFTH. Concrete-steel head-works to this canal, 25 feet in height.

SIXTH. Over seventeen miles of the American Canal enlarged to carry 100 million gallons per day, and with flumes, trestles, sand-boxes, waste-wiers and all appurtenances complete.

SEVENTH. The Pacific House Tunnel, about 2100 feet in length, to divert the waters of the American Canal through the ridge into the Cosumnes Catchment-area above Sly Park. This tunnel is to be of a capacity of 200 million gallons per day and to be furnished with proper head-gates, etc., to control the inflow of the water.

EIGHTH. The fully developed Sly Park Reservoir, of over 11,000 million gallons capacity. This reservoir would be created by two earth dams, one 161 feet in height and the other 92 feet in height; with the necessary spill-way, outlet tunnels, gate-house, etc.

NINTH. A concrete-steel diversion dam 23 feet high in Camp Creek, to divert the waters from Sly Park Reservoir into the High-Line Canal; also the necessary outlet tunnel, head-works, etc., to pass the water from behind the diversion dam into the High-Line Canal.

TENTH. The High-Line Canal, about 15 miles in length, enlarged to carry 100 million gallons per day and provided with necessary appendages such as flumes, trestles, sand-boxes, relief gates, etc., and including a tunnel of about 1000 feet in length.

It is thus seen that if the Bay Cities Water Company's Project be purchased, the City would not only acquire ownership in lands and rights sufficient to provide water for nearly a hundred years to come, but would also acquire works which would be ample to provide its water supply for at least twenty-five years to come. The additional works necessary to increase the developed supply from 88 to 317 million gallons per day would be of relatively low cost and need be added only gradually, throughout a period of seventy or eighty years.

The offer of the Bay Cities Water Company now before San Francisco provides only for bringing the water to the head of a pipe-line leading to the city. Before the city can make use of this water it must be carried many miles in an expensive conduit. In deciding upon the relative merits of two projects for the water-supply of San Francisco, not only the relative costs of the two developed catchment-areas must be considered but also the relative costs of their respective conduits to the City. This was recognized by the Bay Cities Water Company and months of careful study were expended on investigations for a pipe-line from the terminus of their proposed works to San Francisco. Nothing more will be said of this pipe-line investigation than that good data were secured for it and the problem worked out in a very pains-taking and thorough manner. The result of the investigation, stated very briefly, is that the American-Cosumnes supply can be connected with San Francisco by a pipe-line around the south end of the Bay which will be over eighteen miles shorter than the conduit from Tuolumne proposed by Mr. Grunsky; and that the American-Cosumnes pipe-line, with a carrying capacity 22 per cent. greater and a factor-of-safety (margin of strength) 25 per cent greater than the Tuolumne pipe-line proposed by Mr. Grunsky, can be completed for about four million dollars less than his estimated cost for the Tuolumne conduit.

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In conclusion, it is extremely improbable that the Tuolumne supply can ever be secured by San Francisco, and if secured it will yield less

than half as much stream-flow as will the American-Cosumnes area. The partisans of the Tuolumne supply have repeatedly claimed for it, in comparing it with the American-Cosumnes, that it would be without cost to San Francisco. This is not a fact. Even if the Tuolumne could be secured from the Government and were the best source of supply of any, large sums must be expended for dams and canals before a water-supply is developed; while the offer of the Bay Cities Water Company includes the transfer to the City not only of lands and water-rights, but also of all the completed structures necessary to develop a water-supply one-half greater than Mr. Grunsky's proposed Tuolumne supply.

The American-Cosumnes Project of the Bay Cities Water Company offers to San Francisco a supply of pure water, from a practically uninhabited region, sufficient in quantity to serve the city for perhaps a hundred years to come. It offers not only a much larger immediate supply than that proposed by Mr. Grunsky from the Tuolumne, but also at no great increase in cost, for a system completed to San Francisco, above his estimate for the completed Tuolumne system. The capability and practicability of the American-Cosumnes area as a source of water supply for San Francisco has been thoroughly studied and the results placed in form for quick investigation by others. Finally, it has a very decided advantage over the Tuolumne in being controlled by one corporate interest and hence free to be acquired by San Francisco at once, without long delay and probably ultimate failure in attempting to secure permission to use it from the Government; and what San Francisco needs if her prosperity is to be uninterrupted is not only a larger and a better water-supply than she now has, but also that one shall be acquired with the least possible delay.

EDWIN DURYEA, JR., M. Am. Soc. C. E.,
Chief Engineer Bay Cities Water Co.

San Francisco, Cal., March 11, 1907.

A Complete and Exact Copy

of the

# PROPOSITION MADE BY THE BAY CITIES WATER COMPANY TO THE BOARD OF SUPERVISORS

on

April 9 and May 21, 1906.

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April 9, 1906.

To the Honorable the Board of Supervisors of the City and County of San Francisco.

GENTLEMEN:—

In conformity with the conditions set forth in Resolution No. 7130, adopted by your Honorable Body on the 12th day of March, 1906, Bay Cities Water Company, a corporation under the laws of California, respectfully submits the following proposition for your consideration.

For the price hereinafter set forth Bay Cities Water Company proposes to vest in the City and County of San Francisco certain water rights, reservoir rights, water-storage rights, reservoirs, reservoir sites, dams, canals, flumes, ditches and tunnels, rights of way and power house site, together with existing improvements, and further improvements to be made thereon under this proposition, said rights and properties being located in El Dorado, Amador and Alpine Counties, California.

These rights and properties present the following important features, all of which have been conclusively established by the most accurate and detailed investigation of eminent hydrographic engineers, who have been employed upon this work by proponent company for many months past:

FIRST. That the water rights are fundamental and so control the waters naturally flowing in the South Fork of American River and its tributaries above the intake of the El Dorado Water and Deep Gravel Mining Company's canal, and of the North Fork of the Cosumnes River and its tributaries above Buck's Bar; that these waters may be taken to the extent of two hundred or more million gallons per day. See schedule of Water Appropriations marked "Exhibit A".

SECOND. That all desirable water-storage rights within the drain area tributary to the South Fork of American River and North Fork of Cosumnes River, above the points named, heretofore secured by location and appropriation, have been acquired and are comprehended by and included within this proposition. See schedule of Water Reservoir Locations marked "Exhibit B".

THIRD. That the reservoirs embraced within this proposition, including those now constructed and such as these proponents will construct at their own cost under this proposition, have an aggregate storage capacity for reserves against a continuing daily draft of seventy-five million gallons of water. See schedule of Reservoirs marked "Exhibit C".

FOURTH. That when the existing and proposed reservoirs shall be suitably and practicably enlarged and additional reservoirs created upon other available sites, they will comprise storage for that quantity of water requisite to a continuing daily draft of two hundred million gallons of water. See schedule of Additional Reservoir Sites marked "Exhibit D".

FIFTH. That the dams creating the existing reservoirs, and those to be erected by proponents under this proposal, comprise all dams that will be required until such time as the water consumption of the city shall exceed seventy-five million gallons of water per day. See schedule of Dams marked "Exhibit E".

SIXTH. That the existing canals, ditches and tunnels, together with such improvements thereon and additions thereto as proponents will make under this proposal, comprise a system of conduits sufficient for the concentration at a common point, hereinafter referred to, of a quantity of water sufficient to provide a continuing daily draft of seventy-five million gallons. See schedule and brief description of Canals, Ditches and Tunnels marked "Exhibit F".

SEVENTH. That the natural channels, canals and rights of way embraced within this proposition, are such as will be required for collecting waters from the various storage reservoirs and delivering the same at a common point, to the extent of providing at that point a continuing daily draft of two hundred or more million gallons. See schedule marked "Exhibit G".

EIGHTH. That the lands and properties embraced within this proposition and to which fee simple title is to be conveyed to the City and County of San Francisco, embrace various canals, ditches, reservoir land and timber lands, inclusive of a tract of adequate area and suitable location for power generating station and head-works for pipe lines leading therefrom to the City and County of San Francisco. See Property Maps 1, 5, 6, 7, 8, 9, 10 and 11.

NINTH. That this proposition embraces stumpage contracts upon timber lands and easements upon lands privately owned that are required for use in connection with the ultimate conservation and delivery at the upper end of pipe lines leading to the city, of a continuing daily draft of two hundred million gallons of water. See Property Maps 1, 3, 5, 8, 9, 10 and 11.

TENTH. That this proposition also embraces the right to use all lands belonging to the United States Government the use of which has been heretofore granted to proponent and its predecessors, which are essential to the conservation and delivery of a daily supply of two hundred or more million gallons of water as aforesaid. See Property Maps 1, 2, 3, 4, 7 and 9.

ELEVENTH. That the watersheds, the runoff from which is controlled through ownership and control of the water rights, reservoirs and reservoir sites referred to, have the capacity requisite to the production of water in sufficient quantities to provide against a continuing daily draft of two hundred or more million gallons of water per day. See Description of Watershed marked "Exhibit H" and engineering data to be submitted.

TWELFTH. That the daily water supply of seventy-five million gallons above referred to, will be delivered at such an elevation above the headworks of pipe lines leading to the city as to enable the development therefrom of such power as may be required to force that quantity of water through the pipe lines leading to the City and County of San Francisco, and all other electric power necessarily incidental. Also that when the additional improvements necessary to a daily supply of two hundred million gallons are made, that such additional power as will then be required for the same purpose can readily be developed from the water at the same point.

THIRTEENTH. That the point at which the two hundred million gallons of daily water supply can be concentrated under this proposal, consists of a tract of at least forty acres of land located upon the banks of the North Fork of Cosumnes River in El Dorado County, California, about one hundred and twenty miles from San Francisco. And that it possesses the natural advantages requisite to a site for power generating stations, and the intake of pipe lines for the purpose of conveying water therefrom to the City and County of San Francisco. See Property Map No. 11.

FOURTEENTH. That the water procurable from the sources embraced within this proposition, is such as usually originates upon the high, rocky mountains of the Sierra Nevada range; that it is soft, possessed of an unusual degree of purity and is in every respect as desirable for human consumption and general use as any water in the State of California, or elsewhere in the world. See Analyses of the Water marked "Exhibit I".

FIFTEENTH. That the improvements now existing upon said properties, together with those which these proponents will make thereon at their own cost under this proposal, will be such as to amply provide at the point of intake of pipe lines to San Francisco, against a continuing draft of seventy-five million gallons of water per day. A schedule of the improvements to be made by and at the cost of these proponents under this proposal, is hereto attached and marked "Exhibit K".

NOW THEREFORE, BAY CITIES WATER COMPANY, a corporation under the laws of California, under this proposition offers to the City and County of San Francisco

(1) All rights existing under and by virtue of the several water and reservoir site appropriations set forth in Exhibits A and B hereto attached. Also

(2) All the reservoir sites specified and described in Exhibits C and D hereto attached, together with the dams now existing and to be

constructed by these proponents under this proposal, described in Exhibit E. Also the betterments and improvements described in said last named exhibit and in Exhibit K. Also

(3) All the several tunnels, canals, ditches, flumes and conduits described in Exhibit F hereto attached, inclusive of the tunnel to be constructed by these proponents connecting the American and Cosumnes watersheds, as described in said exhibit and in Exhibit K. Also

(4) The several rights of way for the construction of canals, ditches, etc., described in Exhibit G hereto attached. Also

(5) A fee simple title to the several tracts of land indicated upon Property Maps 1, 5, 6, 7, 8, 9, 10 and 11. Also

(6) Easements upon the several tracts of land indicated upon Property Maps 1, 3, 5, 8, 9, 10 and 11. Also

(7) The rights acquired from and ceded by the United States Government, upon the several tracts of land indicated upon Property Maps 1, 2, 3, 4, 7 and 9. Also

(8) All of the improvements to be made upon said properties described in Exhibit K hereto attached.

ALL OF THE FOREGOING RIGHTS AND PROPERTIES, together with the improvements now existing thereon and such as are to be made thereon by these proponents in accordance herewith, to be conveyed to, and delivered into the possession of the City and County of San Francisco by these proponents for the gross purchase price or sum of ten million five hundred thousand ($10,500,000) dollars to be paid to these proponents, their successors or assigns, in United States gold coin at such times and in such payments as may be agreed upon between the Board of Supervisors of the City and County of San Francisco and your proponents, upon the acceptance of this proposition.

For the purpose of comparison merely and of accentuating the value and desirability of this water supply for the City and County of San Francisco, the proponents request your Honorable Board to consider it in relation to the most prominently mooted and heretofore best known proposed municipal water supply, namely, that known as the Hetch Hetchy or Tuolumne system recommended by former City Engineer Grunsky and recently again endorsed by ex-Mayor Phelan.

#1—PRICE. The Tuolumne scheme, assuming that titles and permits can be obtained, would according to the official estimate of Mr. Grunsky, cost the city $39,531,000. This includes the city distributing system. Based on the figures and estimates found in Mr. Grunsky's report on the Tuolumne project, the cost of the water system submitted by proponents, *from the point of intake where the pipe lines to the city commence*, including all pipe lines, pumping plants, safety reservoirs and city distributing system, would not exceed $27,500,000, and might be constructed for considerably less.

Taking the last named figure, however, as a basis, the total cost of the project herewith submitted—complete—would be $38,000,000, making a saving over the proposed Tuolumne supply of over one and one-half million of dollars.

#2—QUANTITY OF WATER. The uninterrupted continuous daily supply furnished from this project on first development, would be seventy-five millions of gallons as against sixty million gallons contemplated by the Tuolumne scheme. Moreover, storage capacity and rights developable to a daily continuing and constant supply of two hundred millions of gallons are included without extra charge to the city, as against a possible maximum development from the Tuolumne of one hundred and sixty million gallons per day.

#3—TITLE. The city will own its own property, its own water, its own reservoirs and its own rights of way, if it shall acquire the property herein submitted. Whereas in the proposed Tuolumne supply it is doubtful whether any satisfactory or sufficient rights will ever be conferred on the city by the Federal Government; and even if such rights should eventually and after additional years of further delay and difficulty be obtained, they might not be permanent and they probably would never amount to a title. We propose to convey and to vest in the city an absolute title as heretofore specified.

#4—QUALITY OF WATER. It is absolutely free from pollution and of the purest mountain sources.

#5—EXPEDIENCY. The waters in this proposed system are taken from the Northern Sierras and from districts everywhere amply supplied with necessary water for irrigation, for industrial enterprises and for domestic purposes. The taking of these waters for San Francisco will make no substantial change or cause any appreciable loss or damage to any of the people engaged in developing the wealth and resources of the State—to the ultimate benefit and advantage of the City of San Francisco; while the taking of the waters of the Southern Sierras as is contemplated by the Tuolumne project, would inevitably bring suffering and injury to and inflict irreparable damage on the vast mining and agricultural industries of the Southern and Central portions of our State,—none too well supplied even now with the prime necessity of their industrial life—pure fresh water—in sufficient quantities for constant and continuous use.

It is this consideration which has moved large bodies of the population of that section of our State to protest against the diverting of their natural water supplies from their own to this city's use; and it is their protest, based on these considerations, which has been given such official heed by the Government officers at Washington as to have prevented San Francisco up to this date, from making any satisfactory progress in the acquisition of the rights necessary to create and develop this Tuolumne scheme of water supply. And irrespective of any legal rights, it would seem to these proponents that the City of San Francisco, seeing its own interests in the fruitful and steady development of the interior portions of our State, would, aside from any ground of sentiment, exercise a wise judgment in securing its water supply from points where neither State development nor private citizen's prosperity would be menaced by the taking of the waters, and preferentially seek its water supply from the abundant and copious sources of the Northern Sierras—scantily drawn upon for local needs—rather than from the sparser sup-

plies of the Southern and Central Sierras, nearly all of which are required for local use.

In conclusion, this company, if its proposition be favorably considered and accepted, will give a sufficient bond absolutely to guarantee to the city the supply indicated of seventy-five millions of gallons of water per day, with potential development to two hundred millions of gallons per day, at the price named. Water deliverable at the point of pipe line intake, and all water, water rights, reservoirs, and rights of way, and all works and constructions necessary to produce said supply of seventy-five million gallons per day (with potential capacity of two hundred million gallons per day as herein set forth) to be delivered and conveyed to the City and County of San Francisco for said price, free and clear of all liens and encumbrances and title clear.

Respectfully submitted,

BAY CITIES WATER COMPANY,

By WILLIAM S. TEVIS, President.

April 9, 1906.

# EXHIBITS

## A, B, C, D, E, F, G, H, I and K

ACCOMPANYING

# PROPOSITION

— OF —

# BAY CITIES WATER COMPANY.

## EXHIBIT A

## WATER APPROPRIATIONS.

The water rights included in this proposition embrace all rights of the El Dorado Water and Deep Gravel Mining Company and its predecessors in interest, to the waters of the South Fork of American River and its tributaries available to the intake of the canal (built by that company and its predecessors), in Section 29 of Township 11 North of Range 15 East, M. D. M., El Dorado County, California. Also to all of the water rights of Bradley, Berdan and Company; Jones, Furman and Company, Eureka Canal Company, Park Canal and Mining Company, and others constituting the Diamond Ridge Ditch System, to the waters of North Fork of Cosumnes River and its tributaries above Buck's Bar, in Section 7 of Township 9 North of Range 12 East, M. D. M., El Dorado County, California.

The appropriations of water here cited are of necessity confined to those appearing upon the official records. The water rights, however, were principally acquired by location and use in 1851 and 1852, at which time recordation of appropriations was not provided for by law. Use under these appropriations has continued without interruption to the present time, and these rights include substantially all the waters of the territory above referred to.

In the following schedule quantities of water appropriated are stated in miner's inches; 77.37 such inches are the equivalent of 1,000,000 gallons per day.

## AMERICAN RIVER GROUP.

| Located. | Miner's Inches. | Waters of Stream or Lake. |
|---|---|---|
| 6 May, 1872. | 20,000 | Martin's Lake. |
| 6 May, 1872. | 20,000 | Silver Lake. |
| 6 May, 1872. | 20,000 | Red or Clear Lake. |
| 6 May, 1872. | 20,000 | Audrain's Lake. |
| 6 May, 1872. | 20,000 | Lakes and Ponds of Slippery Ford branch of South Fork American River. |

AMERICAN RIVER GROUP.—Continued

| | | |
|---|---|---|
| 7 May, 1872. | 10,000 | Alder Creek. |
| 7 May, 1872. | 500 | Mill (sometimes called Wolf) Creek. |
| 7 May, 1872. | 500 | Mill (sometimes called Wolf) Creek. |
| 7 May, 1872. | 5,000 | Plum Creek. |
| 13 May, 1872. | 10,000 | Echo Lakes and Creek. |
| 16 May, 1873. | 10,000 | Alder Creek. |
| 16 May, 1873. | 10,000 | Plum Creek. |
| 16 May, 1873. | 10,000 | Echo Lakes. |
| 16 May, 1873. | 10,000 | Silver Lake. |
| 16 May, 1873. | 10,000 | Red or Clear Lake. |
| 16 May, 1873. | 10,000 | Martin's Lake. |
| 16 May, 1873. | 10,000 | Audrain's Lake. |
| 16 May, 1873. | 10,000 | Slippery Ford branch of South Fork American River. |
| 16 May, 1873. | 10,000 | Strawberry Creek. |
| 16 May, 1873. | 10,000 | All lakes and streams furnishing water to South Fork American River. |
| 16 May, 1873. | 4,000 | Silver Lake. |
| 16 May, 1873. | 5,000 | Echo Lakes. |
| 17 May, 1873. | 4,000 | Audrain's Lake. |
| 28 September, 1874. | All waters. | Plum Creek. |
| 25 October, 1875. | All waters. | Medley Lakes and tributaries. |
| 23 November, 1875. | 10,000 | Twin Lakes. |
| 17 June, 1899. | 10,000 | Medley Lakes at outlet. |
| 11 October, 1899. | 10,000 | Lake Henry, or Lake George. |

COSUMNES RIVER GROUP.

| Located. | Miner's Inches. | Waters of Stream or Lake. |
|---|---|---|
| 2 July, 1872. | 200 | Sly Park Creek. |
| 25 September, 1873. | 6,000 | North Fork Cosumnes River. |
| 25 September, 1873. | 6,000 | North Fork Cosumnes River. |
| 25 September, 1873. | 6,000 | Park Creek. |
| 25 September, 1873. | 6,000 | Camp Creek. |
| 25 September, 1873. | 6,000 | Camp Creek. |
| 8 January, 1875. | 6,000 | Camp Creek. |
| 8 January, 1875. | 6,000 | Park Creek. |
| 8 January, 1875. | 6,000 | North Fork Cosumnes River. |
| 8 January, 1875. | 300 | Sly Park Creek. |
| 17 April, 1875. | 6,000 | North Fork Cosumnes River. |
| 17 April, 1875. | 6,000 | Park Creek. |
| 17 April, 1875. | 6,000 | Camp Creek. |
| 30 August, 1875. | 2,000 | Sly Park Creek. |
| 25 September, 1875. | 4,000 | North Fork Cosumnes River. |
| 25 September, 1875. | 4,000 | Camp Creek. |
| 10 December, 1877. | 500 | Steeley's Fork Cosumnes River. |
| | 10,000 | North Fork Cosumnes River. |

## EXHIBIT B

## RESERVOIR APPROPRIATIONS.

Schedule of reservoir appropriations upon South Fork of American River and the lakes and streams and tributary thereto above the site of the projected tunnel connecting the American and Cosumnes watersheds.

Also of reservoir appropriations upon the North Fork of Cosumnes River and its tributaries above Buck's Bar.

These locations were made pursuant to the provisions of an act of Congress approved July 26, 1866.

NOTE—The appropriations here cited are largely renewals of unrecorded appropriations made prior to the passage of the act of March 27, 1872, requiring that such notices be recorded.

### AMERICAN GROUP.

| Date. | Reservoir Locations. |
|---|---|
| 6 May, 1872 | Martin's Lake. |
| 6 May, 1872 | Silver Lake. |
| 6 May, 1872 | Red or Clear Lake. |
| 6 May, 1872 | Audrain's Lake. |
| 7 May, 1872 | Alder Creek. |
| 7 May, 1872 | Mill Creek. |
| 7 May, 1872 | Plum Creek. |
| 13 May, 1872 | Echo Lakes. |
| 16 May, 1872 | Silver Lake. |
| 16 May, 1872 | Echo Lakes. |
| 17 May, 1873 | Audrain's Lake. |
| 28 September, 1874 | Plum Creek. |
| 25 October, 1875 | Medley Lakes. |
| 23 November, 1875 | Twin Lakes. |
| 23 November, 1875 | Alpine Creek. |

### COSUMNES GROUP.

| Dated. | Reservoir Locations. |
|---|---|
| 25 September, 1873 | Park Ranch. |
| 25 September, 1873 | Hazel Valley. |
| 25 September, 1873 | North Fork Cosumnes River. |
| 16 December, 1874 | Sly Park Creek. |
| 18 October, 1883 | Camp Creek. |

## EXHIBIT C.

## RESERVOIRS FOR DAILY SUPPLY OF SEVENTY-FIVE MILLION GALLONS.

The first three of the following named reservoirs have been constructed and in continuous use for many years. The fourth is to be

constructed by these proponents. These four reservoirs, having an aggregate capacity of fourteen thousand and fifty-eight million gallons, will provide the storage necessary to a continuing daily draft of seventy-five million gallons. The reservoirs are viz.:

#1—SILVER LAKE.

This lake is situated in Townships 9 and 10 North of Range 17 East, M. D. M., Amador County, California, at the headworks of Silver Fork of South Fork of American River and at elevation about 7,800 feet above the sea.

It has been improved and continuously used as a reservoir for more than thirty years; and, as improved, has an available storage capacity for one thousand nine hundred and fifty million gallons of water, which can be very considerably increased at moderate cost.

#2—THE ECHO LAKES.

Comprising Big and Little Echo Lakes, which are connected by a channel. The location is in Townships 11 and 12 North of Range 17 East, M. D. M., El Dorado County, California, and at elevation about 7,400 feet above sea level.

The natural drainage is into the Upper Truckeee River, thence to Lake Tahoe and to the Humboldt Desert. Many years ago, however, the divide was tunneled and the waters brought into the head of South Fork of American River in connection with the waters of which they have since been continuously utilized. The available storage capacity of these lakes, as at present improved, is six hundred and eight million gallons of water. This capacity can be largely increased when needed.

#3—THE MEDLEY LAKES.

This group of lakes, known as "The Devil's Basin," is situated in Township 12 North of Ranges 16 and 17 East, M. D. M., El Dorado County, California, an elevation above tidewater of about 8,400 feet. The basin comprises thirty or forty small lakes hollowed out of solid granite by glacial action, and connected together by narrow channels. They have been converted into a reservoir by the erection of a dam across their common outlet, Pyramid Creek; and, as improved, provide available storage for eight hundred million gallons of water. This available storage capacity is readily susceptible of material increase at very low cost.

#4—SLY PARK RESERVOIR.

This reservoir, to be constructed by these proponents by erection of dams, etc., as later set forth herein, on Park and Hazel Creeks, is to be located in Township 10 North of Range 13 East, M. D. M., El Dorado County, California, and at elevation about 3,500 feet above the sea. It will be so situated that, in addition to its natural tributary drain area, the entire drain area of the upper South Fork of American River and Upper Camp Creek, become tributary to it. The available capacity of this reservoir under first improvements, will be ten thousand seven hundred million gallons.

# EXHIBIT D.

## RESERVOIRS FOR DAILY SUPPLY OF TWO HUNDRED MILLION GALLONS.

As the water requirements of the city from time to time increase beyond a daily consumption of seventy-five million gallons, it will be necessary to increase the aggregate storage capacity of the mountain reservoirs from the total of fourteen thousand and fifty-eight million gallons, provided as per Exhibit C, to a grand total of fifty thousand eight hundred and ninety million gallons. To enable this increase when and as required, the following reservoir sites are to be utilized, viz:

### #1—SILVER LAKE.

The location of this reservoir is stated in Exhibit C. In its ultimate development, through raising the height of the dam, its water retaining capacity can be increased four thousand one hundred and fifty million gallons, providing it an ultimate available storage of six thousand one hundred million gallons.

### #2—TWIN LAKES.

These lakes are situated in Township 10 North of Ranges 17 and 18 East, M. D. M., Alpine County, California, at elevation 7,900 feet above the sea. They are the source of Alpine Creek, a tributary of the Silver Fork of South Fork of American River. The waters flowing therefrom have been utilized for many years, and the lakes have been controlled for reservoir purposes since prior to 1875. Improvements of moderate cost will give an available water storage capacity of six thousand three hundred million gallons.

### #3—AUDRAIN LAKE.

Is located in Township 11 North, Ranges 17 and 18 East M. D. M., El Dorado County, California, at elevation 7,200 feet and is the upper lake source of South Fork of American River. Its waters have been in constant use for a long series of years, but no dam has been erected for restraining storm water flows. By constructing necessary dams, gates, etc., for the installation of which prime natural advantages exist, the lake can be made to provide available storage for one thousand five hundred and seventy million gallons of water.

### #4—THE ECHO LAKES.

For description of location, altitude, etc., see Exhibit C. Through increase of height of dam the original storage capacity of six hundred and eight million gallons can readily be increased to two thousand four hundred and fifty million gallons.

#5—THE MEDLEY LAKES.

The characteristics, location and altitude of these lakes are set forth in Exhibit C. By raising height of existing dam, which can be done at very low cost, the original storage capacity can be increased to three thousand million gallons.

#6—CAPP'S CROSSING.

This reservoir site is located on the North Fork of Cosumnes River in Township 9 North of Range 14 East, M. D. M., El Dorado County, California, at an elevation above sea level of about 5,100 feet. It is an admirable site and, when improved, will provide storage for one thousand six hundred and fifty million gallons of water.

#7—GRANITE BASIN.

The Granite Basin reservoir site is located on Camp Creek in Township 10 North of Range 15 East, M. D. M., El Dorado County, California, at elevation about 4,000 feet. The site is first-class and by easily made improvements, will provide storage for one thousand one hundred and twenty million gallons of water.

#8—SLY PARK.

The location and elevation of this reservoir are fully set forth in Exhibit C, and while quite feasible to do so, the calculations made do not contemplate any increase of the ten thousand seven hundred million gallons capacity there stated.

#9—BUCK'S BAR.

This reservoir site is on North Fork of Cosumnes River in Township 9 north of Range 12 East, M. D. M., El Dorado County, California, at 1,500 feet elevation above sea level. The site is exceptionally fine, and the damsite a wonderful gorge of solid granite. When improved to its capacity, it will store eighteen thousand million gallons of water.

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It is proper to direct attention to the fact that the relative locations of the several reservoirs above described is such that, taken together, they form a remarkably flexible system. Thus, the waters of Silver, Twin and Audrain Lakes may be transferred to Sly Park or Buck's Bar; those of Echo Lakes to Audrain Lake, Sly Park or Buck's Bar; those of Medley Lakes to Sly Park or Buck's Bar; those of Capp's Crossing to Sly Park or Buck's Bar; those of Granite Basin to Sly Park or Buck's Bar, and those of Sly Park to Buck's Bar. The waters of eight of the nine reservoirs, to-wit: Twin, Silver, Audrain, Echo and Medley Lakes, Capp's Crossing, Granite Basin and Sly Park can be delivered at the pipe line intake either by the High or Low Line Canal; Buck's Bar alone being confined to the Low Line.

## EXHIBIT E.

## DAMS FOR DAILY SUPPLY OF SEVENTY-FIVE MILLION GALLONS.

The dams which are now in place creating the reservoir at Silver, Echo and Medley lakes (see items 1, 2 and 3 of Exhibit C), are variously described as follows:

### (1) SILVER LAKE DAM.

The dam across the natural outlet of Silver Lake creating the present storage for water, is a simple but substantial rock-crib structure. It is equipped with appliances for controlling the discharge when the level of the lake is not above the spillway; when above that level the water runs to waste, except as it may be recovered at the American Canal headworks.

The dam has been in use for many years, and while not elegant is thoroughly effective. The present water-storage capacity of the reservoir, as stated, is one thousand nine hundred and fifty million gallons, but economically susceptible of increase to six thousand one hundred million gallons, and probably more.

### (2) ECHO LAKES DAM.

The existing dam across the natural outlet of the Echo Lakes is a substantial structure fully ample to meet the storage requirements of the present and for several years to come. It is what is known as a "one-man boulder" dam filled with earth, and retains in store the six hundred and eight million gallons of water referred to in connection with the Echo Lakes reservoir.

The dam is equipped with the necessary gates for controlling the flow of water from the lakes, and is serviceable for many years. When increase of storage is necessary at this point to provide against an increase in the city's water requirements, a dam of required height can readily be constructed, and at moderate cost, increasing the storage capacity to two thousand four hundred and fifty million gallons. The natural facilities for construction are first-class.

### (3) MEDLEY LAKES DAM.

The waters impounded in the Medley Lakes are restrained by a rock-fill dam erected across the natural outlet. This structure has been in place since 1899, and fully meets all requirements. Material for its enlargement when increased storage capacity is desired, is immediately at hand, and the natural facilities for building a high dam are ideal. A comparatively small investment would construct a dam which would quadruple the present storage capacity of the lakes, bringing it up from eight hundred million gallons as at present, to about three thousand million gallons.

(4) AMERICAN DIVERSION DAM.

At a point in the South Fork of American River in Section 28 of Township 11 North of Range 15 East, M. D. M., proponents will build across the channel of the stream a dam.

This dam will be of stone and concrete substantially constructed on approved designs and provided with all required and convenient accessories for its safety and for controlling the waters of the stream and diverting them into the intake works of the canal leading thence to the tunnel into the Cosumnes watershed, later described herein.

(5) SLY PARK DAM.

This structure is to be erected by proponents for the purpose of creating the additional storage requisite to the proper reserves against a continuing daily draft of seventy-five million gallons of water. It will be an hydraulic fill dam built about a steel re-enforced concrete core-wall, the upper face of the dam being properly protected against water action by a suitable facing of stone rip-rap. The dam will be such as to create the stated storage; it will have an ample and substantial spillway for the care of surplus waters, sluicing and draft pipes of proper dimensions will be supplied, and all necessary and convenient devices and appliances provided and installed conformable with the best engineering practices. The site for the dam is exceptionally fine and the materials at hand from which to construct it are of the very best quality.

This dam will create a storage reservoir having an available storage capacity of ten thousand seven hundred million gallons of water.

(6) HIGH LINE DIVERSION DAM.

Proponents will also erect a masonry dam across Camp Creek in Section 26 of Township 10 North of Range 13 East, M. D. M., for the purpose of diverting the waters from the channel of the stream into the High Line Canal leading thence to the point of pipe line intake. This dam will be of proper dimensions and design, provided with ample spillway for carrying away excess waters, equipped with all necessary and convenient water-controlling devices and safety appliances, and to be first-class in every respect.

## EXHIBIT F.

## WATER CONDUITS FOR DAILY SUPPLY OF SEVENTY-FIVE MILLION GALLONS.

The canals, ditches, tunnels, flumes and other conduits required to collect a daily supply of seventy-five million gallons of water from the various sources of supply, and to deliver the same to the point of pipe line intake, are as follows:

The natural channels of Alpine Creek, Silver Fork and South Fork of American River, and of Pyramid Creek and Slippery Ford Fork are

to be utilized for conveying the waters of Silver Lake, Twin Lakes, Audrain Lake, Echo Lakes and the Medley Lakes, and their tributary drain areas, to the headworks of the American Canal, later described. These channels have been continuously utilized for this purpose for more than twenty-five years, and the right is a vested one.

All of these upper American waters, except those of the Echo Lakes, flow naturally to the canal intake. The Echo Lakes waters are discharged into a conduit consisting of a flume, ditch, tunnel and open channel, and are conducted through the western summit of the Sierra Nevada range of mountains and discharged into the channel of South Fork of American River. These works were originally constructed many years ago and have since been continuously used.

By the above means all the waters originating above the head of the American canal are concentrated in the channel of South Fork of American River at a point in Section 29 of Township 11 North of Range 15 East, M. D. M., where the American diversion dam (to be erected by proponents as per Exhibit E) will divert them into the canal.

The part of the canal of the El Dorado Water and Deep Gravel Mining Company, here called the "American canal," embraced in this proposition, extends from the point above named to the entrance of a tunnel, later described, connecting the American and Cosumnes watersheds in Section 34 of Township 11 North of Range 13 East, M. D. M.

The length of this canal from end to end as above, inclusive of flumes in line, is about 102,960 feet. Of this length about 22,000 feet is made up of 37 flumes of varying length. The remainder, about 81,000 feet, being regular canal section excavated in earth and stone.

The canal has been built and in continuous use for more than thirty years. It was given an original carrying capacity of about one hundred million gallons of water per day. The engineer who made the original location and under whose direction it was constructed, had the courage of his conviction that he was building for all time; the result being that he put the canal where it should have been put, built it as it should have been built, and provided it with ample sand boxes, waste wiers, and other necessary appliances. The good work done has now the seasoning of time, coupled with good maintenance; and to-day, as nearly as may be, it possesses the characteristics and stability of a natural channel. Sand boxes, waste wiers, and other protective devices are placed at frequent intervals along the canal line.

The character of the construction and the natural conditions are favorable to an economical enlargement of the canal section and carrying capacity, which can readily be increased to deliver about two hundred million gallons of water per day.

In the line of the canal a number of ravines were encountered, to cross which flumes were necessary. These flumes begin and end on substantial stone abutments which were well designed and constructed, and are in prime condition. The aggregate length of flumes in the canal section above referred to, is 22,000 feet, of which about 11,000 feet are new, having been rebuilt within the past three years. The remainder is serviceable for a time, but is being rebuilt as occasion requires.

The rights of way of the canal line are 60 feet in width, being 30 feet from each side of the center line as located. These were secured under act of Congress when the canal was constructed, and have been in peaceable possession for nearly fifty years, hence are perfect. The canal is to be put into condition by proponents as indicated by Exhibit K.

Commencing at a point on the canal line in Section 34 of Township 11 North of Range 13 East, M. D. M., and extending thence through the divide between the watersheds of the South Fork of American River and North Fork of Cosumnes River, proponents will construct a tunnel for the purpose of discharging the waters of the canal into the Sly Park reservoir.

The length of this tunnel will approximate 2,000 feet. It will be provided with suitable masonry entrance and discharge portals, and will be concrete lined on sides and bottom and overhead where necessary. The tunnel will be given capacity for its ultimate requirements of about two hundred million gallons of water per day, and will be designed and constructed in accordance with approved plans and specifications, equipped with proper gates and other appliances of safety and convenience, and be first-class in every respect.

The waters from the American watersheds and from Sly Park reservoir will follow the channels of Sly Park and Camp Creeks to the High Line diversion dam (see Exhibit E), where they will be diverted into the High Line canal leading thence to the pipe line intake.

The canal to be utilized for this purpose is the old Jones and Furman ditch, constructed nearly fifty years ago and since used for the conduct of water. This canal originates on Camp Creek in Section 26 of Township 10 North of Range 12 East, and extends thence to a point in Section 2 of Township 9 North of Range 11 East, from which point these proponents will construct a new canal to a point in Section 19 of the same Township and Range, which will be convenient to the pipe line intake and at such an elevation above it as to enable development of power as stated in the twelfth paragraph of proponents' proposition.

The canal will be reconstructed by these proponents from intake to discharge. All headworks, flumes, waste wiers, safety devices, conveniences, etc., being supplied and installed in accordance with approved plans and specifications. The completed canal to have capacity to deliver one hundred million gallons of water per day at the pipe line intake.

## EXHIBIT G.

### Rights of Way.

In addition to the channel, ditch and canal rights of way referred to and described in Exhibit F, to-wit: The channels of Alpine Creek, Silver Fork of South Fork of American River, Pyramid Creek, Slippery Ford branch of South Fork of American River, South Fork of American River, Echo Lakes ditch line, American canal, Jones and Furman

canal, etc., these proponents' proposition embraces the following channels and rights of way:

The channels of Mill or Wolf Creek, Alder Creek and Plum Creek, originally tributaries to South Fork of American River but now tributary to the American canal.

The channel of Camp Creek from Granite Basin reservoir site to the intake of the Jones and Furman canal in Section 26 of Township 10 North of Range 12 East, M. D. M.

A ditch line connecting the channel of Camp Creek in Section 24 of Township 10 North of Range 13 East, M. D. M., with the sly Park reservoir site.

A ditch line connecting the North Fork of Cosumnes River in Section 18 of Township 9 North of Range 13 East, M. D. M., with the channel of Camp Creek and the Jones and Furman canal.

A canal line extending from the Buck's Bar damsite along the north bank of North Fork of Cosumnes River to a point in Section 19 of Township 9 North of Range 11 East, M. D. M., being the point of intake for pipe lines leading thence to the City and County of San Francisco. This covers the location of the so-called Low Line canal.

## EXHIBIT H.

### Description of Watersheds.

The zone of the watersheds comprises an area of 396.53 square miles. It stretches from Cat Point, about eight miles southeast of Placerville, eastward about forty miles to the summit of the high Sierras, and embraces the slopes of two spurs of mountains, having a width of from ten to sixteen miles. Its topographical aspect is typically Sierran, rising from an elevation of 1500 feet, it culminates in altitudes of more than ten thousand feet at the summits of Pyramid Peak, Round Top and Mount Tallac and other high mountains included in the area.

The lower reaches are well wooded with many varieties of conifer, admirably adapted to the conservation of moisture; the upper reaches are granitic, broken and glaciated, stripped of soil, clean and cold, blanketed with perennial snows. Vast reservoirs of water thus lie congealed upon these elevations throughout the year, and yield a continuous flow during the season of greatest heat and drouth.

Only a few spots in this entire territory are susceptible of human habitation, the total population at present aggregating not to exceed three hundred and fifty persons—less than one to a square mile of the tract under consideration. Of these persons nearly all are settled upon flats which comprise the reservoir sites and would, perforce, remove when these spaces become converted to the uses of the city.

About three-fourths of this area has been withdrawn from settlement through being included within the Tahoe Forest Reserve. It is patrolled by forest rangers in the employ of the Government, whose duty it is to prevent trespass and to protect the timber against fires, thereby maintaining those conditions of the watershed favorable to the largest conservation of water, to continuance of running streams and their freedom

from pollution. The precipitation is very copious, the watersheds lying for the most part within the lines marking one of the regions of greatest rainfall in the Sierra Nevada mountains. By reason of the cool climate evaporation is at its minimum, and the surfaces being largely naked rock, there is a maximum runoff; thus the catchment is productive of large quantities of water seemingly disproportionate with its area. The conditions throughout are favorable in the highest degree to great precipitation upon surfaces where the waters may lie or be held free from contamination and from which they may be released in their pure state as the needs of the city may require.

## EXHIBIT I.

### Analyses of Water.

Professor Thomas Price of San Francisco, to whom was submitted for analysis four samples of water taken from widely separated portions of the watershed, has issued the following certificate:

"THOMAS PRICE & SON,
"Analytical & Consulting Chemists,
"509 Commercial St.,
"San Francisco.

"November 6th, 1905.

"Analyses of 4 Samples of Water for Bay Cities Water Company.

| | "SILVER LAKE. | ECHO LAKE. | DITCH. | BUCK'S BAR. |
|---|---|---|---|---|
| | "Grains per Gal. | Grains per Gal. | Grains per Gal. | Grains per Gal. |
| "Calcium Carbonate | 0.872 | 0.651 | 0.405 | 2.426 |
| "Magnesium Carbonate | Trace | 0.092 | 0.273 | 0.518 |
| "Sodium Chloride | 0.320 | 0.151 | 0.421 | 0.256 |
| "Potassium Chloride | 0.123 | 0.108 | 0.274 | 0.125 |
| "Organic Matter | Trace | Trace | Trace | Trace |
| "Total Residue | 1.315 | 1.002 | 2.373 | 3.325 |
| | "Parts per Million. | Parts per Million. | Parts per Million. | Parts per Million. |
| "Free Ammonia | 0.032 | 0.002 | 0.011 | Trace |
| "Albuminoid Ammonia | 0.039 | 0.025 | 0.021 | 0.020 |
| "Nitrates | None | None | None | None |
| "Nitrites | None | None | None | None |
| "Hardness: | | | | |
| "Temporary as $CaCO_3$ | 15 | 13 | 29 | 43 |
| "Permanent | None | None | None | None |

"All of the samples were free from either color or odor, and none of them contained any sediment.

"The foregoing analyses show these waters to possess a degree of purity which is not equalled by that supplied to any large city in the world.

(Signed) "THOMAS PRICE & SON."

## EXHIBIT K.

SCHEDULE OF IMPROVEMENTS WHICH BAY CITIES WATER COMPANY WILL CREATE UPON PROPERTIES INCLUDED IN ITS PROPOSITION.

*One:* Deepen the channel connecting Big and Little Echo Lakes to a point on a level with the present outlet of Big Echo Lake.

*Two:* Repair existing dam on Big Echo Lake and replace headgates at the outlet with new gates of substantial construction.

*Three:* Overhaul, repair and replace flume now connecting Echo Lake outlet with ditch leading to tunnel; clean out ditch and repair portals to tunnel.

*Four:* Overhaul Medley Lakes dam and put in new and substantial outlet gates.

*Five:* Put in new low diversion dam of concrete or masonry construction across South Fork of American River at head of American River canal.

*Six:* Replace existing headworks of American canal with new substantial structure, inclusive of gates for governing inlet of water to canal, and proper provision for waste of excess water.

*Seven:* Clean out American canal and so increase the carrying capacity thereof through deepening and widening channel by excavation and raising of berm, as to give it a carrying capacity of not less than one hundred million gallons per day.

*Eight:* Inclusive of all improvements to be made by these proponents as in this exhibit set forth, to make such provisions as good engineering practice prescribes for the delivery of a continuing daily supply of seventy-five million gallons of water at the lower end of the High Line canal hereinafter described. Said provisions to be made either by adding to the capacities of the reservoirs described in the preceding Exhibit C or by otherwise creating additional storage above the intake of the High Line canal and by increasing the earth and rock sections of the American canal to a carrying capacity of not less than one hundred million gallons per day; repairing such of the existing flumes thereon as are in good condition; and replacing such as require replacing, and giving all said flumes a carrying capacity of at least one hundred million gallons per day, or alternatively, by a combination of increase of storage and of canal carrying capacity as these proponents shall elect.

*Nine:* Build such suitable waste water wier on line of American canal adjacent to inlet of tunnel connecting American and Cosumnes watersheds, as shall be necessary to dispose of excess water accumulating at that point.

*Ten:* Build tunnel through divide between American and Cosumnes watersheds. Said tunnel to be of full concrete construction with suitable concrete entrance and discharge portals; to have a capacity of two

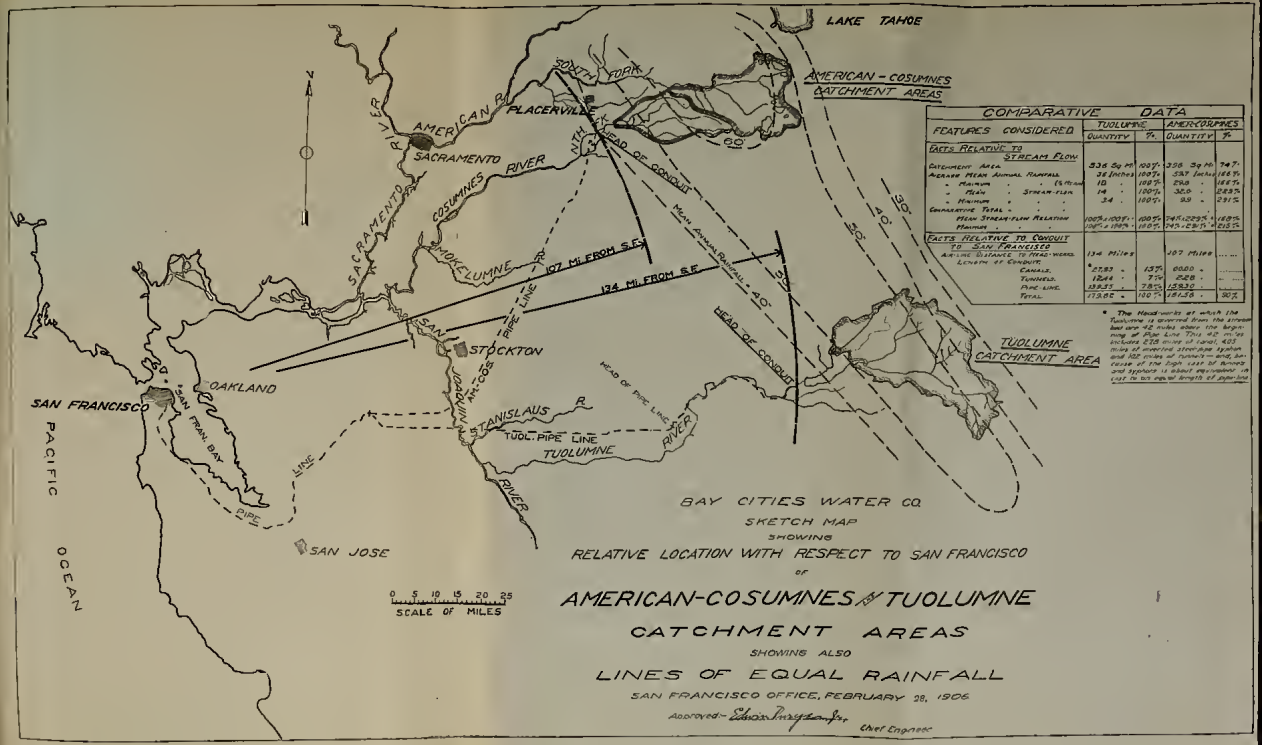
hundred million gallons per day; and to be provided with all necessary gates for controlling the entrance of water thereto.

*Eleven:* Remove buildings, fences, trees, etc., from the site of the Sly Park reservoir, and put same in proper sanitary condition for storing water for human consumption.

*Twelve:* Construct necessary earth-fill dams with concrete core-walls of sufficient heights, to create storage in Sly Park reservoir for ten thousand seven hundred million gallons of water. Said dam to be provided with proper gates for controlling the discharge from said reservoir and proper gates, pipes, etc., for sluicing the same. Also to be provided with proper spill-way for discharge of excess water and all requisite safety devices.

*Thirteen:* Construct a suitable masonry diversion dam across Camp Creek at head of High Line canal, leading thence to the common point hereinabove referred to. Said dam to be equipped with proper sluice gates, pipes, and safety devices and appliances.

*Fourteen:* Clean out, enlarge, reconstruct and extend the High Line canal extending from the diversion dam next above referred to; building all flumes, tunnels, etc., necessary to said canal line and giving the same a carrying capacity of one hundred million gallons of water per day. Said canal to be equipped with all necessary headgates, waste wiers, etc., and to terminate at a point sufficiently above the point chosen for headworks of pipe lines extending thence to the city, to enable the development of power as above stated and the discharge of the waters into pipe lines extending to the City and County of San Francisco.




| COMPARATIVE DATA | | | | |
|---|---|---|---|---|
| FEATURES CONSIDERED | TUOLUMNE | | AMERICOSUMNES | |
| | QUANTITY | % | QUANTITY | % |
| *FACTS RELATIVE TO STREAM FLOW* | | | | |
| Catchment Area | 536 Sq mi | 100% | 356 Sq mi | 147% |
| Average Mean Annual Rainfall | 38 Inches | 100% | 53.7 Inches | 166% |
| " Maximum " (5 yrs) | 10 " | 100% | 29.8 " | 184% |
| " Mean " Stream-flow | 14 " | 100% | 35.0 " | 248% |
| " Minimum " " | 3.4 " | 100% | 9.9 " | 291% |
| Comparative Total " | | | | |
| Mean Stream-flow Relation | 100% / 100% | 100% | 147% / 229% | 148% |
| Maximum " " | 100% / 184% | 100% | 147% / 216% | 215% |
| *FACTS RELATIVE TO CONDUIT TO SAN FRANCISCO* | | | | |
| Air-line distance to Head-works | 134 Miles | | 107 Miles | ..... |
| Length of Conduit: | | | | |
| Canals | 2583 " | 13% | 6080 " | ..... |
| Tunnels | 1844 " | 7% | 228 " | ..... |
| Pipe-line | 13537 " | 78% | 15830 " | ..... |
| Total | 17964 " | 100% | 18138 " | 101% |

* The Head-works at which the Tuolumne is diverted from the stream bed are 42 miles above the beginning of Pipe Line This 42 miles includes 228 miles of tunnel, 422 miles of inverted steel-pipe siphon and 132 miles of tunnel and surface of the high side of Aqueducts and Syphons is about equivalent in cost to an equal length of pipe-line

BAY CITIES WATER CO.

SKETCH MAP

SHOWING

RELATIVE LOCATION WITH RESPECT TO SAN FRANCISCO

OF

# AMERICAN-COSUMNES & TUOLUMNE

## CATCHMENT AREAS

SHOWING ALSO

## LINES OF EQUAL RAINFALL

SAN FRANCISCO OFFICE, FEBRUARY 28, 1906

Approved— Edwin Duryea Jr. Chief Engineer

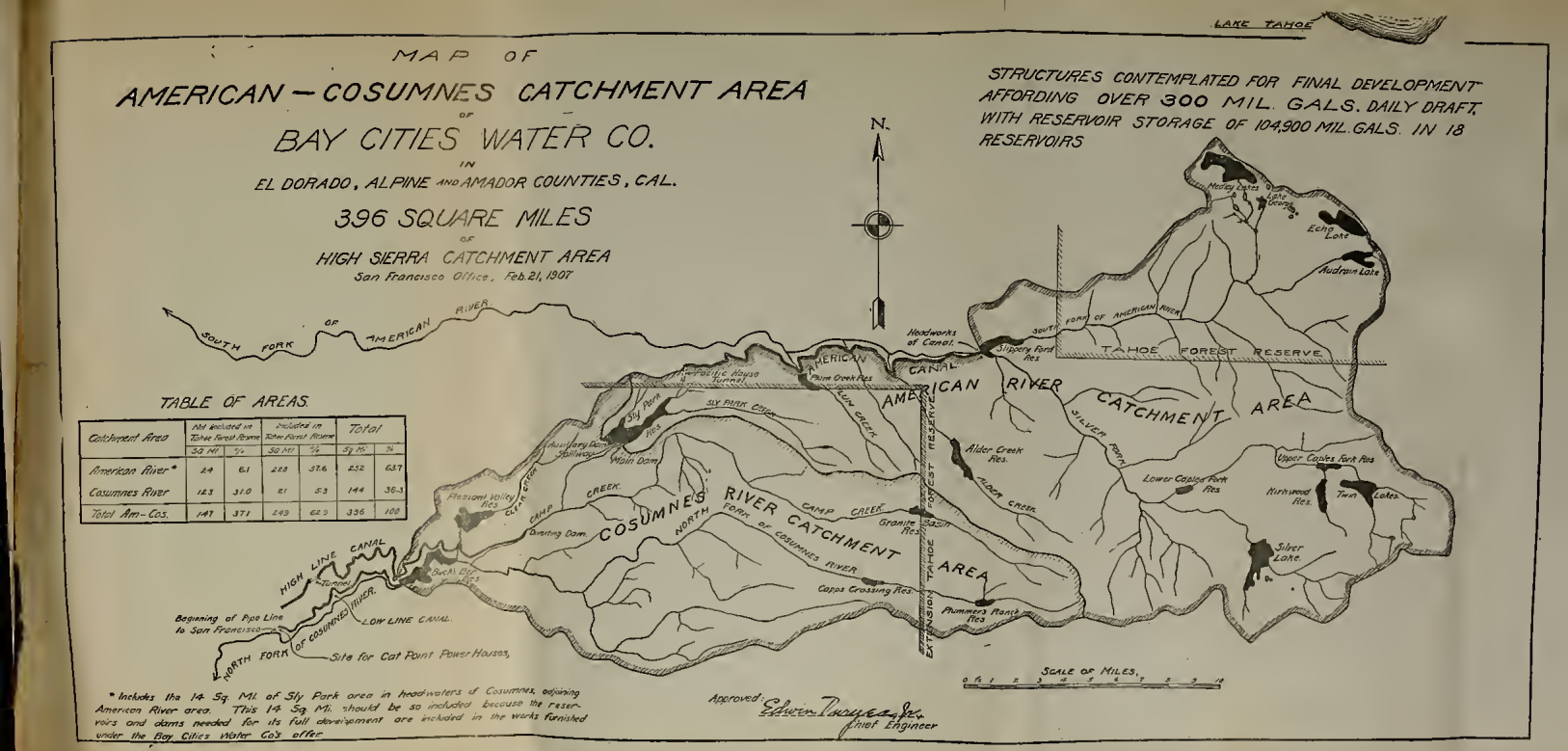



TABLE OF AREAS.

| Catchment Area | Not included in Tahoe Forest Reserve | | Includes in Tahoe Forest Reserve | | Total | |
|---|---|---|---|---|---|---|
| | 32 Mi | % | 32 Mi | % | Sq Mi. | % |
| American River* | 24 | 61 | 228 | 376 | 252 | 637 |
| Cosumnes River | 123 | 310 | 21 | 53 | 144 | 363 |
| Total Am-Cos. | 147 | 371 | 249 | 629 | 396 | 100 |

* Includes the 14 Sq Mi. of Sly Park area in headwaters of Cosumnes, adjoining American River area. This 14 Sq Mi. should be so included because the reservoirs and dams needed for its full development are included in the works furnished under the Bay Cities Water Co's offer.

Approved: Edwin Duryea Jr.
Chief Engineer

# THE QUALITY OF THE WATER

FURNISHED BY THE

# CONTRA COSTA WATER CO.

Compared with that supplied

Eastern Cities.

Oakland City Council

# CONTRA COSTA WATER.

Owing to many complaints reaching us respecting the quality of the water furnished our citizens, we think it necessary to publish the official analysis of the water supplied by the Contra Costa Water Company.

The City Council of the city of Oakland ordered an analysis of the water supplied to the citizens by the Contra Costa Water Company, and the following are the reports furnished the Council:

DR. LEGLER'S ANALYSIS.

OAKLAND, October 1, 1881.

*To Dr. J. R. Bradway, Health Officer of the City of Oakland*—SIR: In compliance with your request, I have made a careful examination of the Oakland city water, as furnished by the Contra Costa Water Company, and herewith enclosed present my report.

Respectfully,

H. T. LEGLER, M. D.

SANITARY EXAMINATION OF CITY WATER.

Water taken from the faucet in the Health Office, City Hall, derived from Lake Chabot, near San Leandro, during the time from August 28th to September 3d, was uniform in appearance, clear, showing only a slight opalescence. It contained the animalculæ, and was moderately palatable. It contained the animalculæ common to pond and river water in moderate quantity. Chemical examination showed that it contained no poisonous metals, and only traces of iron. According to this and to the sanitary analysis given in the table below, it is to be classed as stored upland surface water of medium purity. There are added, for the sake of comparison, the analysis of the water of several other cities, and the average quantity of impurities in rain, upland surface and spring water, as given by Professor E. Frankland.

SANITARY ANALYSIS OF OAKLAND CITY WATER.

| DESCRIPTION. | *Parts per 100,000.* | | | | | | | *Hardness.* | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Total Solids... | Organic Carbon | Organic N trogen. | Free Ammonia. | Nitrogen as Nitrate & Nitrites | Total Nitrogen combined. | Chlorine..... | Temporary..... | Permanent..... | Total..... |
| Oakland City Water..... | *24.0 | .240 | .013 | .003 | .140 | .156 | 2.1 | 9.3 | 4.0 | 13.3 |
| Oakland Rain Water..... | 3.0 | .070 | .015 | .029 | .003 | .042 | .2 | .... | .... | .3 |
| Upland Surface Water..... | 9.6 | .322 | .032 | .002 | .009 | .042 | 1.1 | 1.5 | 4.3 | 5.4 |
| Upland Spring Water..... | 28.2 | .056 | .013 | .001 | .383 | .396 | 2.5 | 11.0 | 7.5 | 18.5 |
| London Water Supply..... | 28.0 | .201 | .033 | .001 | .210 | .239 | 1.7 | .... | .... | 20.0 |
| Birmingham Water Supply..... | 25.6 | .255 | 055 | .002 | .214 | .274 | 1.7 | .... | .... | 16.0 |
| Glasgow Water Supply ..... | 3.0 | .186 | .011 | .... | .004 | .016 | .7 | .... | .... | 1.0 |
| Philadelphia (Schuylkill River). ... | 10.0 | .... | .045 | .014 | .290 | .347 | 1.4 | .... | .... | .... |

(*) Of the 24 parts solid 2.1 parts were organic matter.

## ANALYSIS BY STATE ASSAY OFFICE.

State Assay Office, Safe Deposit Building, Room No. 16, S. E. corner California and Montgomery streets, San Francisco, September 16, 1881. No. 7,001.

Analysis of water furnished from Lake Chabot, near San Leandro, by the Contra Costa Water Company, and taken from faucets in Oakland. Received August 29th from J. R. Bradway, M. D., Health Officer. Total fixed ingredients in 1,000 00 parts, 23 8-10 parts, or per imperial gallon, 16 66-100 grains, consisting of: Carbonate of lime, 7.143 parts in 1,000.00, or 5 grains per gallon; carbonate of magnesia, 4.842, or 3 389; carbonate of soda, 2.544 or 1.783; sulphate of soda, 3.958, or 2.771; chloride of sodium, 2.913, or 2.039; organic matter, 2 400, or 1 680.

The organic matter, on close investigation, proved to be derived from vegetable nitrates, nitrites and ammonia, which accompany the decomposition of animal matter, could be found in minute traces only by applying the most delicate tests. The water, which has now stood in our laboratory for eighteen days, is still free from odor and color, which affords a good technical proof of its freedom from pollution by animal matter. A slight sediment at the bottom of the vessel in which the water was kept, consisted of finely-divided vegetable fibre. The lime and magnesia are contained in the water in the form of bicarbonates, and on boiling or exposure to the atmosphere are precipitated as insoluble carbonates.

In our opinion, the water we have analyzed answers all the requirements of good, potable water.

FALKENAU & REESE.

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## ANALYSIS AT STATE UNIVERSITY

UNIVERSITY OF CALIFORNIA,
BERKELEY, October 1, 1881.

*To the Honorable, the Board of Health, Oakland, California:*

I beg leave to submit the following report of the examination of three different samples of water, taken at different times and places from the city water works. The examination was made solely to ascertain whether the water was suitable for domestic purposes. I shall, in a short time, submit a more elaborate report, when I will give the results of work now unfinished.

I have determinined the free ammonia, the albuminoid ammonia and the nitrates and nitrites.

Free ammonia, parts in a million: I, 0.08; II, 0.07; III, trace only. In 100,000, 0.008; 0.007; albuminoid parts in a million, 0.11, 0 08, 0.09; ammonia in 100,000, 0.011, 0.008, 0 009.

The amount of nitrates is not large, and varies somewhat. I wish to withhold the exact amount for a confirmatory test. The above analysis places the water among the good waters which may be used for all domestic purposes.

Very truly,
W. B. RISING.

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We have thoroughly examined into the matter, and find that the same trouble exists for indefinite periods at certain seasons of the year in the water supplied to nearly all the cities and towns in the United States and Europe; whether such supplies are taken from rivers, streams, natural lakes, ponds, made reservoirs, or even wells.

The governing bodies of these cities and towns have from time to time appointed Commissioners, mostly composed of expert hydraulic engineers and professors of chemistry to examine waters with odors and tastes similar to the water supplied Oakland; these examinations have embraced the most minute detail, aided by the microscope and severe chemical tests, and have been conducted by such eminent men as Professor W. R. Nichols, of the Massachusetts Institute of Technology, G. Lawton, Professor of chemistry at Dalhousie College, Professor Silliman, analytical chemist, Professor Torry, Dr. Chilton, Dr. Jackson, S. Dana Hayes, State assayer and chemist of Vermont, Professor A. R. Leeds, of Stevens Institute of Technology; Chas. M. Cresson, M. D., Professor at the Chemical Laboratory, Philadelphia; Dr. Farquharson, Dr. Carpenter (General and Comparative Philosophy), Prof. Bailey, of West Point (a distinguished microscopist), and Dr. W. G. Farlow, Professor of Botany in Harvard University.

None of these gentlemen consider such water deleterious to health, in fact it

is decided that were water contaminated with injurious elements such as sewage, the vegetable matter and animalcules could not exist, being deprived of existence by such poisonous ingredients.

The following statements on this subject are gathered from official sources as they appear in the printed reports made to the City Councils or other governing bodies of the various cities and towns enumerated below:

## ALBANY.

[Report for year 1877, page 14.]

No one will question, that when water is impounded in this climate in shallow reservoirs, it is very liable to acquire an unpleasant taste and odor; by increasing the depth of water we cannot wholly escape this.

[Pages 36 and 37.]

Science has as yet failed to discover a remedy for the impurities that so frequently affect water supplies in this climate, or the causes that produce them. True, they are attributed to an excess of animal or vegetable life, and we are told if the proper equilibrium between these is disturbed, an unpleasant taste and odor are imparted to the water. But what disturbs this equilibrium? Until this is established, no remedy can be applied with any hope of success; nor is it probable, even though we could trace the impurities from their real origin to their full development, that we could hasten their destruction or even lessen their effects.

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## BOSTON.

[Report of 1875 and 1876, page 37.]

Early in October complaints began to be made at the office of the Water Board, that the Cochituate water tasted badly and was unfit for use. The taste was variously described; some persons thought it like cucumbers; others like fish oil; still others like dead leaves, etc; but as a rule, it was spoken of as a cucumber taste. On October 26th the Brookline and Chestnut Hill reservoirs were visited; but the cucumber taste could not be detected in the water contained in them. Water taken in front of the screens of the efflux gate-house of the Chestnut Hill reservoir was tasteless, but a sample taken from behind them, or at the mouth of the outlet pipe, was found to have the cucumber taste in a slight degree. At that date the taste may be said to have been confined to the water in the pipes; but on the next day, it was discovered in all parts of the Bradlee basin of Chestnut Hill reservoir, having spread through that large volume of about 500,000,000 gallons of water in one night apparently.

Prof. Wm. R. Nichols, of the Massachusetts Institute of Technology, was requested to make thorough investigations to ascertain the cause of the trouble; that its recurrence might be prevented if possible, and he engaged Mr. Edward Burgess, Secretary of the Boston Society of Natural History, and Dr. W. G. Farlow, Assistant Professor of Botany in the Harvard University, to aid him.

These gentleman have made a very complete study of the matter, but are unable to assign any cause for the taste.

Similar trouble existed in the year 1881, and again is now so bad (1883) that drinking water is peddled from door to door in carts.

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[Report of 1877, page 9.]

Many cities have suffered from lack of water, while we have had enough and to spare. The annoyance on account of the quality was of short duration, and shared in common with most towns. It is, of course, impossible to form a perfectly just idea of the amount of the vegetable growth in the reservoir. This vegetable matter, when alive and scattered through the water, gives scarcely any noticeable taste or odor to the water, but in its decay becomes offensive, and when the water is delivered in the city, it is unpalatable and sometimes possessed of an unpleasant odor. In the summer of 1875 I found a copious growth of microscopic plants, an *alga* of the *hostoc* family. The present year I have examined the water constantly, and although there has been, until December 1st, more or less of a green scum in the water, sometimes, indeed, quite abundant, I have found only one or two individual plants of the kind that was so abundant last year. The mass of the green matter this year is of an entirely different plant, and in order that there might be no doubt in the matter I requested Dr. W. G. Farlow, Professor of Botany in Harvard University, to iden-

tify it. He pronounced it to be *clathrocystis aeuginosa*. Having my attention called to the matter, I have observed the samo plant abundantly the present year, in other ponds and reservoirs. With reference to the recurrence of the growth I may say that all ponds are liable to more or less of this growth of microscopic plants, whether they are natural or artificial. A case came under my observation this summer, where a pond which has been used for yoars, without complaint, becamo suddenly filled with a growth very similar, and the accumulation of the decaying vegetable matter on the surfacc, became extremely offeusive. I am inclined to thiuk that even if filtration were performed at the reservoir, it would be doubtful if all cause of complaint, on the part of the consumer, would be avoided in the city.

[Report of the Water Works Association, held at Buffalo, 1883, pages 26 27.]

Mr. Ellis—The filter in question which Mr. Croes refers to at Springfield, is a thing of the past. Our filter is different from anything that has been described here to-day. We have a reservoir of about four hundred and forty-five acres, holding approximately two billion gallons of water, more than we could use the whole year if we did not have raiu. The consequencc is, it is a stagnant pool. Its average depth is perhaps twelvc or fourteen feet, aud at its deepest poiut is some thirty feet. We are troubled with vegetable growth. It was to prevent this minute growth, which decays and impregnates the water aud gives it an offeusive odor, that our present filter was put in. When the filter was constructed, and the four acres of filter-bed was full, it was as shallow in its average as the pond itself, and the consequence was, that eveu if it did lose somo of its vegetable growth above the filter, it would grow below faster thau it did before, and we still had bad water in the pipes. The best plan we have found so far (as this vegetable growth seems to be diffused on the surface, and rarely more than four feet bclow the top) is, by drawing our water below that depth, thus getting rid of all the live growth, but when it comes to decay, which causes this offensive odor to the water, it fails to rid us of that. If there is anyone here who can tell us how to disposo of this vegetable growth in water, I would like to hear from him. We are satisfied that the water is all right, and we do uot have any trouble with it, until the temperature rises above sixty, and when the temperature falls below that, it is all right again. Our water to-day is all right, and perhaps by the middlo of June or first of July it will be far from satisfactory, owing to the vegetable growth which passes into the pipes. We bave made some experiments the past year, with sand-filters, to see what effect that would have, and got very good water in the trial basin, pumping out twice in tweuty-four hours the water that passed through the sand. We kept out so much as was alive of this vegetable growth, but that which was dead we could not avoid. The point with us is to prevent its formation.

Mr. Cameron—Did it affect the health of the city?

Mr. Ellis—As far as the records of the physicians show, it did not.

Mr. Cameron—Why do you wish to get rid of it?

Mr. Ellis—It is offensive to the nose, is the main reason.

## CHICAGO.

[The following extract was taken from a Chicago paper of November, 1883.]

The water is declared so impure that much sickness is attributed to the sewerage matter contained in it, and it is proposed to extend the crib two miles further into the lake.

## COLUMBUS.

[Report dated April 1st, 1876.]

Mr. Frank Doherty, Superintendent, on pages 42, 43, 44, 45, remarks:—When the subject is fairly considered, this water must be admitted to be more pure and healthy than that procured from the wells and even from filtered cisterns also. False impressions are still held by numbers of our citizens regarding the comparative purity of the water furnished by our works and that obtained from filtered rain water and from wells, who have not given the subject sufficient thought, or they may, perhaps, have been deluded into the belief that because the water from the wells is clear to the sight and sweet to the taste, that therefore it must be pure. For these or other reasons they do not become consumers of the works, but are content with water

obtained from wells, situated in close proximity to the many cess-pools, drains and sinks of the crowded city, it is but natural that this water should be very bad, possibly so that the senses of smell and taste might detect it, but were you to continue pumping, this smell and taste would disappear, and you would soon draw water so pleasant to the taste as to be pronounced *sweet*, as sure an indication of sewage as was the first of taste and smell and far more dangerous because the first would be discarded at once, while the last would be welcomed as a luxury. Apply this theory to the water supplied from our works, and if from their location, there was a possibility of sewage entering in exceedingly small quantities, the amount of pure water diluting it is vastly so much greater as to leave it far purer than the well waters of the city, and should be considered a much safer beverage for use, in that the possibility of its contamination is so remote, while the chances that the well water of the city is polluted is such an almost certainty.

## CINCINNATI.

[Report dated December 31st, 1882.]

Pages 105 and 106 quoting from the *Sanitary Engineer*: The question of supply of water to our large cities, including their suburban towns, is becoming more and more serious every day, and among these a lavish use of water is the most common, and the one whose absence is most severely felt. Most people cannot be made to understand that water in the house to be used at all, is in reality, an expensive luxury, and not only so, but that it is a difficult one to provide on a large scale.

The question is almost appalling in its magnitude, and in the seriousness of the consideration of the comfort and even the existence of the dwellers in great cities, which are involved in the procuring of a sufficient supply of water for their use.

## HALIFAX.

[Report of 1877-78, page 79.]

Extracts from report of Mr. George Lawson, Professor of Chemistry, Dalhouse College.

Having visited with you in September, 1878, the sources of water supply to the city of Halifax, with a view of ascertaining, if possible, the cause or causes of impurity; I beg now to state some of the observations then made: The water belongs to the class of soft waters, such as are collected in districts where there are no chalk or limestone strata or other rocks, capable of yielding soluble substances; in comparing the Halifax water with that of similar waters elsewhere, we find that the average solid matter of six such waters, viz: those of Plymouth, Davenport, Glasgow, Aberdeen, Perth and Manchester, amounts to grains 3.775 per gallon. The water of Long Lake corresponds very nearly with this, being 3.840. But the lower Chain Lake sample, shows an amount of solid residue (5.120 grains in excess of the water of any of the places named.).

It is obvious, that the excess of impurity is taken up by the water in its course from Long Lake through the Chain Lakes to the city inlet. It may be added that a few specimens of fresh water sponge (spongilla) whose decay, gives a very offensive odor to the water, were found in the upper Chain Lake, but neither there, nor in the other lakes, were any of the plants found, which are commonly known to render water noxious. In Spruce Hill Lake, the surface of the water was in many places, especially near the shore, of a brilliant green color, from the growth of a microscopic alga, called *Trichormus Flos-aquæ*, which has been observed to give a green color to the water in the Grand Canal Dock at Dublin, and have been observed also in Scotland, France, Wales, Germany and Finland. It is not known to be injurious, but is regarded as an indication of water being stagnant or containing organic matter.

## CITY OF HOLYOKE.

[Report of Dec. 29th, 1876, page 9.]

At the time of making the last annual report the quality of the water supplied to the city had so deteriorated from some cause which has never been satisfactorily explained, as to cause great anxiety and inconvenience throughout the city. The abnormal condition of the water, the peculiar "fish-like" taste, and the other unpleasant qualities, and the means resorted to for remedying the difficulty are fully detailed in the last report; the

water continued in this unpalatable condition until the thirtieth day of March last, when it was discovered that the bad taste and odor had suddenly and entirely disappeared; the duration of the trouble was therefore a little more than five months, during which period neither the most careful microscopic examination nor chemical analysis, by skillful experts, revealed the presence of any disturbing or noxious elements in the water, or gave any clew to the cause of this deterioration, nor is it certain that any of the means resorted to for the purpose of mitigating or removing the evil had any effect whatever.

Many persons are confident that the dead body of some animal decaying in the pond is the cause of the bad taste. I am convinced that this solution of the problem is out of the question. Repeated chemical examination of the water could hardly have failed to detect an abnormal amount of ammonia and nitrogenized animal matter, if such were the case.

[Report of 1875, pages 18, 19, 20 and 21.]

It is well known that New Haven, New Britain, Westfield, South Hadley, Boston and other places, have suffered from bad water the past season. The report of Prof. Silliman on the Norwich Water Works, in 1873, says that the most general statement was that the water had a "fish-like" odor or flavor. At Hartford and New Haven the same difficulty has been experienced. In the latter city the trouble in 1864 was described as a fishy odor and taste, which returned in 1865 in a more offensive form, and again in later years. The Ridgewood water, which supplies Brooklyn, N. Y., was affected with the same peculiarity of taste in 1862, so that many abandoned its use, and the fishy odor was also present. The water supply of Winsted, Conn., took on the same condition in 1862. Burlington, Vt., which is supplied by pumping from Lake Champlain, suffered from poor water in 1870, showing that the germs of the evil, whatever they are, may exist in very large bodies of water. The report of the Albany Water Board for 1865 speaks of two distinct causes affecting the Albany reservoirs at different periods in past years, the one giving to the water the taste and odor of fish, the other imparting to it a musty odor and taste. The reservoirs supplying Williamsburg, in this State, and numerous others, have repeatedly changed in quality, to a noticeable extent. The waters of the mountain ponds in Otis and that section of the State, are well-known by those living near them, to assume an altered condition in some years which is spoken of as "fomenting." In a report submitted to the Croton Board in August, 1859, Professor Torrey says, from his examination, together with the researches of Dr. Chilton: I think we are warranted in concluding that the recent offensive condition of the Croton water was owing to a rapid and abundant growth of microscopic conferva-like plant, which abounds in a volatile, odorous principle soluble to some extent in water. I have not yet satisfied myself as to the origin of these little filaments, whether they are entire plants, or once constituted a part of a more complex algæ. They are more minute than any true conferva known to me, being only 2,500th to 2,000th of an inch in diameter, and from a 50th to a 20th of an inch long. The following, from reports of water boards, show what is positively known upon the subject:

1st. The impurities have made their appearance in the spring, in the summer, and in the autumn.

2nd. They have appeared in reservoirs supplied from creeks and from rivers.

3rd. They have also appeared in reservoirs supplied from lakes sometimes small and shallow, and sometimes large and of great depth.

4th. They have appeared in October, and continued to February, notwithstanding the severity of a northern winter.

5th. In some instances the impurities have disappeared within a short time after their discovery, in others they have continued for months.

6th. The waters of rivers and wells have also been affected. When the offensive odor and taste appeared in Cochituate lake, they were also found in Round pond, which supplied Haverhill; in Jamaica pond, the waters of which are usually exceedingly pure, and in several wells near the lake, and also in Chicopee river.

7th. The impurities, whatever their origin, are not deleterious to health.

## HARTFORD.

[Report dated March 8, 1862, on pages 19, 20.]

Professor B. Silliman, Jr., Analytical Chemist, says: If proper care is taken in the construction of reservoirs, and in cleaning up the ground which they are to cover, the effect of storing the water will be to improve it in every particular, as compared with the waters of the stream. In such a favorable soil much confervoid growth has developed itself with the progress of the season, and by the last of June some of these plants, existing in great numbers, have reached their limit and died, producing a decomposition and the discrimination of many filaments of vegetable growth through the water. This trouble has reached its hight by the middle of July, and then rapidly disappeared.

The chief cause of difference between spring water and river water is, that the former is the result of nature's process of filtration through the soil, and the porous layers on the surface, while the river water represents the rains plus the wash of the surface. The spring No. 3 of this report was perfectly brilliant, colorless and brisk, but the process of filtration had been carried too far; the organic matter was almost all removed, and some new inorganic elements added, which render the water unsafe for use with lead.

[Report dated March 1, 1872, pages 19 and 20.]

The Joint Special Committee appointed by your honorable body, with power to examine into, and take such measures as they may deem necessary, to remedy the existing impurities in the water supply, have had the matter under consideration and beg leave to report.

Your committee have sought information from every source, and by every means, and desiring to co-operate with the Board of Water Commissioners, they have rendered the committee important aid in their investigations. The opinions of scientific men in our midst have been had, besides an analysis of the water, both from the reservoir and hydrants, by Professor C. T. Jackson, of Boston, an eminent chemist and State Assayer of Massachusetts. Your committee, in the exercise of their own judgment, aided by the opinion of several citizens whose judgment, from their intelligence, aided by observation, entitled them to respect, started with the theory of an organic growth upon the inner surface of the pipes, known in the language of science as *crotonic cooferve*, which is a vegetable growth chiefly, which growth is developed and matured by a certain degree of high temperature. when it becomes disengaged, and by the current of the water in the mains is washed into the extremities and "dead ends" of the service pipes, where it precipitates, decomposes, becomes stagnant, and thus contaminates the water in the vicinity of the impurity. The analysis by Dr. Jackson, which is herewith submitted, corroborates the theory advanced at the outset by the committee. The analysis shows but a small per cent. of organic matter, none of it being animal.

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## LYNN.

[Report dated December 31, 1876, page 6.]

Except for a brief period in the heat of summer, when the water in one of the ponds had an unpleasant taste and smell, it has been generally acceptable to customers. A public water supply drawn from ponds or rivers, has to grow gradually in favor with any community. Accustomed to sparkling well water, the pond water at first seems flat and insipid, but with use this soon wears away, and the most prejudiced would hardly be willing to return to the old wells, especially after a knowledge of the fact, that in many localities, the clear well water often contains the germs of disease, the existence of which, the palate gives no indication.

[Report dated December 31, 1877, page 4.]

During the months of June, July, August and September, the water in the Birch Pond reservoir, was again rendered unpalatable by the peculiar taste imparted to it, by what is known as microscopic vegetable growth. This minute vegetable growth, which at times, affects so unfavorably the water in our storage basins, is not peculiar to this locality. The reports received at this office in exchange for our own, make frequent mention of the appearance in the water sources in other towns and cities, of this cause of contamination. No natural water which is exposed to the air, whether in pond or river, is never entirely free from vegetable growth.

Light and certain degrees of temperature and stillness are requisite for the normal growth of these algae, and the decay often takes place in the mains aud service pipes; it will not infrequently happen, that the water in a reservoir or pond will have almost no taste, while the water as delivered to customers will have a decided taste.

LONG BRANCH.

[Report of 1877, pages 3 and 4 ]

The water has not been submitted to a chemical aualysis; this was not thought necessary, as its superior quality cannot be questioned. Its softness has already been tested in the best, most reliable and satisfactory manner, by its use in the laundries attached to the numerons hotels. There is no point in the drainage area from which any deleterious organic matter flows into the stream. Chemically pure water is not attainable from natural sources; rain water takes up impurities in its passage through the atmosphere, springs, wells, brooks, rivers, and lakes, all contain mineral salts or organic impurities, absorbed from the drainage area. While most of these are discovered and their amouuts determined by analysis, to obtain the best results a noted chemist has stated that nothing excels a critical examination of the drainage of a given source, for by a knowledge of the geology, topography, physical and commercial features of a watershed, the quality of the water obtained from it is best determined. The danger of using water obtained from wells, in thickly populated districts, is hut slightly appreciated, particularly where it is employed for culinary or drinking purposes. The open sand and gravel upon which the town of Long Branch is built, allows impure matter thrown upon the surface, or deposited in pits to percolate through iuto the water-bearing strata, and although the water obtained from the wells may have no color, or odor, still it often contains highly objectionable and sometimes poisonous matter.

LAMBERTVILLE, N. J.

[Report of 1882, Page 7.]

The result of examinations of the different kinds of water used by the citizens of Lambertville show: First—That the well waters are not of a kind to be commended for drinking and culinary purposes. They are generally contaminated with surface drainage to a greaetr or less extent; some of them are not by auy means economical where soap is used, being too hard for general domestic use. Second—That the water of Island creek, though soft, is in the late summer and early fall months, apt to be contaminated with the product of decaying vegetable matter.

LIVERPOOL, ENGLAND.

[Report of 1875, Page 34.]

No water was pumped from the Dudlow lane well during a considerable portion of this year, in consequence of pollution by organic matter from the neighboring cesspools.

MANCHESTER, N. H.

[Report of 1872, Page 29.]

To the decomposition of spontaneous growths within the pipes and in the basin is attributed much of the peculiar fishy odors that have proved so objectionable iu the waters flowing from many of the newly constructed storing basins. Analysis of waters such as emit these fishy or cucumber odors, usually detect large percentages of vegetable oils and wax, and indicate a preponderance of vegetable over the due proportion of animal organisms.

MONTPELIER, VT.

[Report of 1873. Page 18.]

S. Dana Hayes, State Assayer and Chemist, says: There are no nitrates, ammonia, nor sewage in either of these samples; No. 3 should be selected as the best. It has a slightly yellowish tint, caused by purely vegetable coloring matter, like that dissolved from dried leaves by running water. No. 1 contains less organic (vegetable) matter, and possessing rather better keeping qualities than No. 2, is the next best water, although the difference between No. 1 and No. 2 is practically of very little consequence; and either of them is a much safer and purer water than that from wells sunk in the vicinity of dwelliug-houses, stables, or other common sources of gradually increasing contamination.

The average amouut of impurity in upwards of seventy-five samples of well water, as given in published reports in the hands of your Commitee, was upwards of forty grains to the gallon, while

twenty-five analyses of waters furnished by public works to different cities and towns in this country give an average of over six grains of solid matter to the gallon.

## NEWARK AQUEDUCT.

[Report dated November 30, 1881. Pages 20, 21, 22.]

Professor A. R. Leeds, of Stevens Institute, of Technology, says: The first analysis was from water drawn on June 7th. It will be seen that the water drawn at that time was in good condition. It then began to deteriorate, and by the 20th of the same month, was open to some complaints, the amount of albuminoid ammonia having risen to .03 parts in 100,000, which is twice the amount permissible in good drinking water. The conclusion drawn from the analysis was that while the Passaic water was below the staudard of unexceptional drinking water, it was but little, if at all, inferior to the Croton.

## NEW BEDFORD, CONN.

[Report dated December 27, 1877. Page 19.]

During a few weeks in the summer the water had an unpleasant taste, owing, in a great measure, to the decaying vegetable matter in in the storing reservoir.

## NEW LONDON, CONN.

[Report dated September, 1880. Page 28.]

As this report may fall into the hands of some who are not acquainted with the location of your supply, I may be permitted to say that the water is taken from a pond of some 225 acres area, which was made by raising a natural pond. While in some places the water is shallow, it is generally at least 12 to 15 feet deep, and in some places as much as 50 feet deep. The lake was filled in 1872, and, I understand, until the present year has given no trouble. In the latter part of October the disagreeable odor began to be noticed, and at the time of my visit, December 20th, the odor was very marked throughout the pond. It was not possible to distinguish any difference between the surface water and that taken from a depth of 45 feet.

It is unfortunate that while the odor (with the accompanying somewhat unpleasant taste) is well recognized as a trouble to which stored surface water is liable, we do not as yet know the cause, nor do we know of any means by which the trouble can be prevented.

In the case of your lake, however, we have not to deal with a new reservoir, but with one which has been filled for seven years, and even the samples taken from the bottom at depths of 25 and 40 feet, show very little color, and contained only a very small amount of organic matter. Some persons have thought that the dead body of some animal decaying in the pond might cause the odor, but I am very certain that no such effect could be in this way produced without our being able by chemical examination to detect in the water some of the other products of decay. Other theories still have been suggested, but I think we must honestly confess our ignorance of the real cause. Judging from the experience in other localities, I should expect but little improvement in the lake until spring, especially now that the surface is frozen over. There is no evidence, as far as I am aware, that the water is at all unwholesome, and it is quite likely that it may qe years before there is a recurrence of the difficulty.

I cannot help feeling that your trouble is similar in its nature to that which has twice affected the Boston water supply.

## PHILADELPHIA.

[Report of the year 1874, page 31. Report of Chas. M. Cresson, M. D., dated March 3, 1875, from Laboratory, Philadelphia.]

That the extreme variations in the amount of organic matter in these samples amount to but 16.2 per cent., while that of the sewage varies to the amount of 220 per cent., and the water containing the greatest amount of organic matter really has in it but traces of sewage. In the whole range of chemical analysis there is no determination which surpasses that of ammonia in point of delicacy. The Wessler test is capable of indicating one part ammonia in 200,000,000 parts of water.

The cities and towns draining into the river Schuylkill above Fairmont dam, number 17, with a population of 90,000. The pollution of the Schuylkill river has been increased to such an extent as occssionally to class the water as unwholesome, prompt measures should therefore be taken to relieve it of sewage containing faecal and decaying animal matter.

[Report dated October 2d, 1877, Page 17.]

Water though theoretically made up of only two elements without perceptible taste, color or smell, is never supplied by nature, chemically pure, analysis prove that it always contains, in a greater or less degree, foreign matter gathered from many sources. The only true method of furnishing pure water is to maintain the purity of the source of supply, by diverting from it as much as possible, all sewage, manufacturing refuse, etc. Humbar, Kirkwood, and other hydraulic authorities, all unite in saying that to be cleansed of its impurities, water should not pass through the filter beds at a more rapid rate of deseent than six inches per hour, or twelve feet per day, and in this simple fact lies the expensive feature of the system, for to purify one million gallons of water per day, requires, at the above rate, 13,500 square feet of filtering area.

It would seem best to first restore the purity of the Schuylkill river, by diverting from it the refuse matter poured into the river by the sewers between Flat Rock and Fairmont dams. This done, a storage capacity equal to several weeks supply would enable us to get rid of much of the remaining impurities by subsidence, and oxydation by exposure to the air.

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## ROCHESTER, N. Y.

[Report dated January 1st, 1875, page 7.]

There has been no time during the past year when water in the Genesee river has been plentiful in supply, when it has not been so muddy as to be unfit for any use, without settling, except for extinguishment of fires, sprinkling streets, lawns or gardens, and, on the other hand, when it has been clear, it has been in such scant supply as so compel the use of the steam pumping set. Such has been the actual continuous experience, that whenever the water was not muddy there was not enough to be had. As to its hardness, the testimony has come from every quarter that it was on that account unavailable, and its use for either domestic or manufacturing purposes has been everywhere repudiated, except where none other could be had.

[Report of 1879, page 23.]

In the early part of July, 1878, a peculiar reddish appearance was observed in the water of Hemlock lake, about two miles up from the outlet. It seemed to be due to something coming from the bottom, which spread near and on the surface of the water, and was held in suspense, a strong wind from the south prevailed, which drove this matter held in suspense to the shore at the lower end of the lake, and the action of the hot sun upon it, seemed to decompose it very soon, when it gave off a very strong, fish-like odor, identifying it with the odor which caused so much trouble in the autumn of 1876.

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## ROCK ISLAND.

[Report of February 28, 1877, on pages 15, 16 and 17.]

In Dr. Farquharson's report on the quality of water, he says: That of the seven specimens of water examined, only one, No. 4, was found to be bad or unfit for use as drinking water; this water, though very clear, bright and sparkling (from aeration), destitute of odor, and possessed of no disagreeable taste, yet gave decided evidence of being largely charged with chlorides, sulphates, ammoniacal salts and organic matter.

The six other waters were very much alike, animalculæ were found in every instance. On this subject Dr. Carpenter [General and Comparative Physiology,] says: It must not be supposed, however, that these animalculæs, as the name "infusory," sometimes given them, would seem to imply, are confined to infusions of organic matter, for, although they mostly abound in such, there is no collection of water, fresh, salt or stagnant, in which they are not present. Again, Professor Bailey, of West Point, a distinguished microscopist, who, after classifying and naming the several animalculæ, says: You will see by the above report that living hard and soft-shelled polygastric infusoria are present in all these waters, and so far the evidence is *in favor* of their salubrity, for if they were not present, it would necessarily be in consequence of something injurious to animal life being present in the water. Some of the species found are such as inhabit the

purest lakes and streams, and many of them would be instantly destroyed in putrescent waters.

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## TOLEDO.

[Report of 1877, Pages 23 and 24.]

The unacceptable condition of the water, as noted in former reports, continues to seriously militate against financia success. It is always difficult to impose reason, although based upon fact and logic, against custom, however unjustifiable, or to resist the deep-seated prejudice which leads to the erroneous belief that our wells and cisterns furnish purer and more healthful water than the Maumee river; neither is it so very wonderful that persons, uninformed in such matters, continue to regard limpidity as the standard of purity, in contradistinction to the various inorganic constituents which, although practically harmless in effect, render water turbid and unsightly. On the other hand, the foregoing objections are frequently resorted to as pretexts to avoid payment for water actually used.

Rain water, as it falls from the clouds in sparsely settled districts, is comparatively pure and unobjectionable; but in large manufacturing districts and cities, is liable to be seriously contaminated with poisonous gases from the atmosphere, and also with various organic impurities washed from the roofs of buildings. Hence its great tendency to become putrid and offensive; when allowed to remain quiet, even for a short time, in covered cisterns. Well waters, especially in populous districts, have been so often and universally condemned as totally unfit for domestic use, that it would seem almost needless to again advert to them. No one, I think, who is in any manner familiar with the sanitary and chemical literature on the subject, will attempt to claim that such waters, however clear and sparkling, are potable or otherwise suitable for culinary purposes. Without a known exception, they are found by analysis to contain a superabundance of chloride of sodium (or common salt) which is generally taken as indubitable evidence of dangerous contamiuation from sewerage, public or private, and from house, stable, privy, and other poisonous drainage.

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## WILMINGTON.

[Report of 1877, page 61.]

We must call the attention of Council to the effects as developed in Dr. Wolfe's report of the sewerage of the northern slope of the city, which finds its way into the Brandywine; also, the drainage from the Wilmington and Brandywine Cemetery, as commented upon by Dr. Bush in his report; these are matters for the serious consideration of Council and must be met in the near future; if the city continues to grow in that direction, the sewerage must increase, and if bodies are interred in the cemetery they must decay, and water polluted more or less, will finds its way into our reservoirs for use as long as the pumphouse remains where it is.

*Preserve for Future Reference*

# Municipal Ownership

OF

# Water and Available Sources of Supply for Oakland, California

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## Report of Citizens' Committee

JANUARY 10, 1903

Oakland. Citizens' Committee.

R. H. Chamberlain
John L. Howard
Warren Olney
Sol Kahn
James P. Taylor
—*Committee*

Oakland Enquirer

## PREFACE

The Mayor of Oakland, Mr. Anson Barstow, in the month of April, 1902, appointed a committee, consisting of R. H. Chamberlain, John L. Howard, Sol Kahn, James P. Taylor and Warren Olney, to investigate and report upon "Municipal Ownership of Water and Available Sources of Supply." The Committee accepted the appointment and began the work of investigation. It soon found that it would be necessary to have some money to pay for services of engineers, and asked the Mayor and Council to appropriate a sum sufficient for that purpose. This was refused, and when it was found that the Committee was really in earnest to ascertain whether or not a water supply could be found independent of the Contra Costa Water Company, their appointment was revoked. Thereupon a petition, signed by more than fifteen hundred citizens, was presented to the Committee, asking it to continue its work, and about forty-three hundred dollars was raised to pay expenses. The Committee acceded to the request, and after patient and careful examination made a report. The Committee that raised the necessary funds for expenses herewith presents to the people of Oakland that report and begs a careful reading of it. It seems to this Committee that this report points the way to municipal ownership of a water supply, and freeing the city from the domination of the Contra Costa Water Company.

OAKLAND, JANUARY 9th, 1903.

TO THE CITIZENS OF OAKLAND:—

The undersigned, complying with a request signed by fifteen hundred or more citizens, asking us to make an "investigation concerning the Municipal Ownership of Water and Available Sources of Supply," have made a careful investigation of these subjects, and respectfully submit the following report:

We make acknowledgment of the financial aid rendered by the contributors to a fund placed at our disposal, which has enabled us to obtain engincering talent of a high order, without which assistance our labors and the conclusions to which they might lead would have had little value as a guide for the action of our people.

This report is not the place for a general discussion of the municipal ownership and operation of public utilities, nor does the duty assigned to this committee call for extended argument. On the broad subject probably there would be found, among the members of the Committee, as much difference of opinion as exists among thinking men who have considered this matter; but UPON ONE POINT THIS COMMITTEE IS AGREED—THAT UNDER EXISTING CONDITIONS THE CITY OF OAKLAND SHOULD OWN AND DISTRIBUTE THE WATER SUPPLY TO ITS CITIZENS.

As pertaining to this particular utility, the following facts appear:

Of the one hundred and thirty-seven cities in the United States each having a population of 30,000 or more, one hundred and one own their Water Works, while thirty-six do not. Fifty-six cities as large, or larger, in population than Oakland, including Oakland itself, only ten do not own their water supply. Of the thirty largest cities, having populations ranging from 108,000 upward only two—San Francisco and New Orleans—do not own their water supply systems, and the latter city has already committed itself to the acquisition of a municipally owned supply. Several cities are added every year to the list of those which have acquired Municipal Water Works; while very few, if any, instances can be cited where cities, having acquired a municipally owned supply, have turned the business over to private parties.

## PROTECTION OF PUBLIC HEALTH.

The protection of the Public Health is a consideration of the highest importance, and we believe that this will be most effectively promoted by the Municipal Ownership of Water Supply; regulations to insure freedom from pollution can generally be more strictly enforced under these conditions, and a city will certainly be found more ready to incur expense for filtration and for other measures necessary to promote the purity of its water than a private corporation.

The operation of a Water Works plant, unlike many other enterprises involving a large investment of capital is quite simple, and does not require a numerous operating force or a largenumber of employees in any department. A superintending engineer of scien-

tific attainments and good executive ability, can easily and with a small force, do all the work that is necessary to supply the inhabitants of Oakland with water, if that water and a good distributing system is owned by the city.

Financial considerations also appear, on the whole, to favor Municipal Ownership of Water. Mr. Bird S. Coler, late Comptroller of the city of New York, whose knowledge of the subject and whose honesty will hardly be questioned, is authority for the statement that the water system of that city is a paying investment, "that after paying the interest on the bonds issued to acquire it "and provide for the principal, there remains a substantial profit "over the cost of maintenance; that while large sums must be ex- "pended in the future for extensions, yet the receipts will increase "even more rapidly than the expenditures, and it is only a matter "of time when the city will own, free of debt, a vast system of Water "Works that will return to the public treasury a very large net in- "come."

## EXPERIENCE OF LOS ANGELES.

Mayor M. P. Snyder, of Los Angeles, writes to this Committee under date of December 18, 1902, as follows: "From February 1, 1902 to November 30th, 1902, the Los Angeles Domestic Water "Works have produced for the city a profit of approximately $220, "000. You will notice, however, that the expenditures have been "greatly enlarged by reason of improvements and extensions of the "water plant. PUBLIC OWNERSHIP HAS BEEN DEMONSTRATED TO BE "A SUCCESS IN LOS ANGELES SO FAR AS THE WATER SYSTEM IS CON- "CERNED."

The relative charges for water in Los Angeles and Oakland will be shown later.

Bonds issued for Water Works are not ordinarily paid out of taxation, and interest charges are included in the annual appropriations, if at all, only as a matter of bookkeeping, because the income derived from water sold is ample to pay both interest and sinking fund requirements in addition to the cost of maintenance and operation.

## SPECIAL REASONS AFFECTING OAKLAND.

While the tendency on the part of all progressive cities toward Municipal Ownership of their Water Supply seems very strong, it appears to us that there are reasons of peculiar weight and force why Oakland, as a municipality, should take over to itself this business. Our people are suffering under a very high schedule of water rates. While complete data for comparison is not at hand, it may be safely asserted that our rates are among the very highest in the country. Flat rates here are fully double those of Los Angeles. The metre rate here to moderate consumers is nearly five times the rate in force in Los Angeles, being at the rate of thirty-three cents per 100 cubic feet in Oakland against seven cents in Los Angeles. Our rates are based upon an excessive capitalization (the result of a consolidation of two competing companies) upon a valuation of the existing plant, which we believe is greatly in excess of the sum

necessary for the city to acquire for itself an adequate supply and a far superior distributing system, and upon a rate of interest on such valuation which is fully twice as much as a prosperous city like Oakland should pay upon any bonded indebtedness it might incur to acquire a plant of its own.

## SOURCE OF INCOMPETENCY AND CORRUPTION.

By virtue of a provision in our State Constitution, the duty of fixing rates for water supplied by the private corporation for use both by the city and the inhabitants, devolves upon the City Council. It is manifestly for the immediate financial interest of the private corporation that the rates should be fixed as high as possible. On the other hand, it is natural that councilmen should be subject to some pressure on the part of consumers to have rates fixed on a low scale. The provisions of the Constitution as to the basis or data which shall govern the council in their action on water rates, are found in practice to be of very uncertain interpretation, and they have been made to cover almost any rates, high or low, which a council may choose to impose. THE CONFLICTING INTERESTS OF CORPORATION AND CONSUMER HAVE BEEN, AND WITH THE CONTINUANCE OF PRESENT CONSTITUTIONAL PROVISIONS, EVER WILL BE, A PROLIFIC SOURCE OF INCOMPETENCY AND CORRUPTION IN OUR MUNICIPAL GOVERNMENT. With the public mind in a constant state of agitation on this subject (a condition which is the natural result of present excessive water rates), we see developed a strenuous effort on the part of the corporation to secure the election of members of the legislative branch who can be counted on to favor its interests; while on the other hand, there is danger that candidates will be nominated and supported by a large element of voters, solely on the basis of their supposed or professed attitude toward this one question rather than on their general high character and integrity and their capacity for dealing with public affairs. EXPERIENCE HAS SHOWN US THAT THESE CONDITIONS ARE SURE TO LEAD TO INEFFICIENCY AND CORRUPTION IN OUR GOVERNMENT. The motive and the opportunity for bribery are then present, and it has been well said that no safeguards of the law can prevent corruption when both parties are willing.

## DEBAUCHES THE PUBLIC SERVICE.

No officer of a city government, who is under obligation to a public utility corporation for his nomination and election, or for any other reason, is capable of judging fairly between the interests of a city and its citizens on the one part and those of such corporation on the other.

Although the law was framed to prevent oppression, yet in its construction and execution it has proved a failure. It has been fruitful only of constant conflict between the interests involved; of costly litigation; of corruption in municipal politics; of suspicion in the public mind regarding the integrity of officials; of complaints as to the quality of water, and of the inadequacy of service; and, more

than all, it has failed of its very purpose to bring about such reasonable rates as are satisfactory to the great body of water consumers.

THE EVILS WHICH THE PEOPLE OF OAKLAND SUFFER, UNDER THE UNFORTUNATE SYSTEM WE HAVE JUST REVIEWED, HAVE BECOME UNENDURABLE.

It may now be proper to anticipate and to answer the chief argument that is currently used in opposition to municipal ownership, viz: "The public cannot successfully administer." The eminently satisfactory financial results shown by one of the largest publicly owned and operated water systems in the country, the Metropolitan system in Massachusetts, could be cited as one example to the contrary; but that the management of such an enterprise by a municipality is not ordinarily as carefully and economically conducted as by a private corporation, we think must be admitted.

The differences are manifest.

## A CONTRAST AS TO METHODS.

In the private corporation the officials and servants are appointed under the tests of ability and fitness for their respective positions. They are actuated by the single and common purpose of making an adequate profit on the capital intrusted to their care, and each is held to an account of personal responsibility; their management being gauged by the financial results that it yields.

Under municipal control the appointments are usually not made upon such tests. There is not the same common incentive spurring officials to give their best efforts to the service, and there is lacking the sense of either immediate or remote personal responsibility, excepting to public opinion, which in some instances has been held in silent or open contempt.

These are the real differences; they do not affect the principle of municipal administration, but they do affect the results. Knowing this, bad results are deserved by any community that entrusts its interests to incompetent, indifferent, or bad agents. But even unsatisfactory results are likely to be far preferable to many of the evils that follow in the train of the present system based upon the laws of our State.

It is evident that with this public service function in the hands of a private corporation, the business is not free from interference and dictation by political manipulators. It is also subject to levies for campaign purposes and in various ways large expenditures are demanded and made of a nature that could not be charged on the corporation books, if the latter were open for public inspection. The claim is then made, on behalf of the corporation, that high rates and large earnings are necessary in a business that is subject to the whims of city officials, to compensate for the risk it takes of being unfairly treated at their hands.

## OPINION OF AN AUTHORITY.

We dismiss this branch of our report with the following additional quotation from Mr. Coler's work on Municipal Government: "There is no feature of Municipal Government more firmly estab-

"lished than the simple business proposition that cities should own "and control their Water Supply. An abundant and inexhaust- "ible supply of water is just as essential to the life of a city as "ground on which to build and air to breathe.

"The experiment of private ownership of water has been tried "in various countries and ages, always with unfortunate results. "Aside from business considerations, the Private Ownership and "control of the Water Supply of a city is repugnant to every sense "of freedom and independence. When people of intelligence unite "their interests in a close community, they must of necessity make "common cause of certain indispensable rights and privileges, chief "among which are the means of healthful existence."

We recommend that the citizens of Oakland take action towards securing a Water Supply System under Municipal Ownership. This conclusion has been reached after careful and unprejudiced investigation of the facts, independent of public sentiment on the subject, but we feel sure it is in accord with that of the property-owning and tax-paying portion of our community.

## SOURCES OF SUPPLY.

Your Committee, having come to the conclusion that our city should own its water works, has given much time and thought to investigating the sources of water supply. To this end we have employed competent engineers and made more or less extended examination of a number of sources, and have rejected, as either too expensive, or inadequate, all except four, which are: 1. San Pablo and Pinole Creeks, supplemented by artesian wells within the city limits. 2. The Contra Costa Water Works. 3. The Niles gravel bed, usually called by engineers the "Niles Cone." 4. Alameda Creek. We take them up in their order for discussion:

### I.

### SAN PABLO AND PINOLE CREEKS.

About eight millions of gallons of water per diem can be obtained from San Pablo and Pinole Creeks by the construction of a reservoir on either one of said creeks and connecting, by means of a diverting dam and flume, the flow of the water from the other creek to the reservoir. The most serious objection to the character of the water from Pinole Creek can be obviated by diverting the water before it reaches the alkali lands on said creek. The water shed of these two creeks is thirty-two (32) square miles. The water shed of the San Leandro Creek, which supplies Lake Chabot, is forty-one (41) miles. The rain fall on the San Pablo and Pinole water sheds is nearly two inches greater than on the San Leandro creek water shed. We are of the opinion that the city of Oakland would fare as well if supplied with water from San Pablo and Pinole Creeks as it does now from San Leandro Creek, leaving out of consideration the additional water supply that the Contra Costa Water Company obtains from its wells below the Niles Cone. Under the laws of this State the city of Oakland may exercise the right of eminent domain, and has the power to condemn the lands it may need

bed undergoes a natural process of filtration and is of the best quality. It is better than it is possible to make the water from San Leandro Creek or from any other creek whose water shed is not high up on the mountains or covered by a growth of brush and timber. Of late years the experience of large cities in Europe and in the East, and of the communities in Southern California, demonstrates that ground water is of better quality and less subject to variations of season than surface waters. At the present time fifty-four per cent of American cities are dependent on ground water. Brooklyn gets all of its water from wells. London and Paris are largely supplied from that source. We understand that Vienna and some other large cities use only ground water. The trend of engineering authority seems to favor ground water if it can be obtained. The Bay Cities Water Company, that proposes to utilize the waters of Coyote Creek in Santa Clara county, and expects to obtain 50,000,000 gallons per diem therefrom, intends to pump the water from a great gravel bed, into which the creek flows, instead of building restraining dams. The gravel bed thoroughly filters the water. There can be no doubt that the Niles gravel bed constitutes an immense natural reservoir of filtered water, from which sufficient may be obtained, not only for Oakland, but also for Berkeley and Alameda, unless the inflow into this reservoir is permanently cut off.

Can the inflow into this great natural reservoir be permanently cut off ? Your committee has employed two competent engineers to investigate the subject and they are not agreed as to whether it is possible to cut off this inflow. The Spring Valley Water Works has already constructed a dam to bed rock a short distance above Niles by which the visible surface flow of the creek is diverted in summer to San Francisco. Both engineers are agreed that this diversion of the six millions of gallons daily of water flowing through the canyon will not deprive the gravel bed of a sufficient supply to subserve the needs of the people on this side of the bay. Both are agreed also that this reservoir is so large that, though we should have a season when no water at all came down the canyon, the supply in the reservoir would not be exhausted. Mr. Hicks, a competent engineer, testified that this natural reservoir holds a supply sufficient for two and a half years. We are informed that there never has yet been a season when water did not come down the canyon and flow into this gravel bed.

One of our engineers, Mr. W. H. Sanders, of Los Angeles and Pomona, has had great experience in developing subterranean waters in Southern California. As is well known, the fruit orchards of that section of country are wholly dependent upon irrigation, and, the rain fall for the last five years having been small, the horticultural interests of Southern California have been preserved by developing subterranean waters, which have been proved to be far in excess of any heretofore supposed possibilities. Mr. Sanders has been very successful as an engineer in this work of developing ground water. He believes that the Niles gravel bed is in part supplied by

percolation from the valleys above through openings in the rock below the surface of the apparent bed rock. In support of his theory he cites to us the experience of the owners of irrigating wells driven into the gravel beds below the mouth of San Antonio Creek north of Pomona. From these wells a large amount of subterranean water is obtained for irrigating the orchards below. A tunnel was driven across the San Antonio Creek just above the gravel bed and on the bed rock, in order to intercept all the water that came down the creek and which did not pass over the surface of the creek bed. It was supposed that by doing so it would tap the source of supply of the wells driven in the gravel bed below. The plan did not work, for it was found that the supply of water to the gravel bed was not affected and the wells still continued to receive their water from the water shed of the creek.

Mr. Rudolph Hering, whose reputation in the United States as an engineer is second to none, was brought by your committee from New York to investigate the same matters submitted to Mr. Sanders. Mr. Hering is most conservative in his opinion, and while he believes and reports that the Niles gravel bed, under present conditions, will afford an ample supply of water to Oakland, yet does not say that it is impossible for the Spring Valley Water Works, by future operations, to cut off the inflow into the gravel bed.

Mr. Sanders believes the inflow into the gravel bed cannot be shut off by anything that can be done by the Spring Valley Water Works, because he is of the opinion that more water falls on the water shed of Alameda and Calaveras creeks than comes down the visible beds of those creeks or is taken up by evaporation or plant life. and therefore must escape into the gravel bed at Niles through apertures in the rock below the apparent bed rock.

Your committee is not competent to say which of these two engineers is right, and does not believe it possible to decide the question save by actual test. Of course it is not a practical question and will never be decided if the Spring Valley Water Works does not undertake to prevent a sufficiency of storm water coming down Alameda and Calaveras Creeks to keep the Niles gravel bed full. We do not believe a conflict between the Spring Valley Water Works and the city of Oakland on this proposition is likely to arise. The reasons for this will more fully appear when we come to discuss the work of that corporation on our side of San Francisco Bay. But if the Spring Valley Water Works should succeed in preventing a sufficient inflow into the Niles gravel bed from the winter rains, the condition of Oakland will not be as unfortunate if it owns its own waterworks as it will be if it continues to depend on the Contra Costa Water Company, for the reason that the city will be in a position by virtue of owning its distributive system and a pipe line to Niles to compel the Spring Valley Water Works to give us water at Niles paying it a reasonable compensation therefor. The wells known as the Dingee wells derive their water, no doubt, from these same gravel beds, and if the inflow to these beds is cut off, Oakland must be the sufferer whether she owns her own water works and pumping

plant or depends upon the works and pumping plant of the Contra Costa Water Company. If she owns her own water works she will be in a position to treat with the Spring Valley Water Works as the necessities of the case require.

This brings us to the discussion of a subject of the utmost possible importance, not only to the city of Oakland, but to the cities of Berkeley and Alameda and the outlying districts contiguous to those cities, and which must inevitably in the near future become a part thereof, viz:

IV.

SPRING VALLEY WATER WORKS AND ALAMEDA CREEK

The city of Oakland now has a population of about eighty-two thousand and is rapidly growing. The cities of Alameda and Berkeley are rapidly growing. The community including these three cities now constitutes an important portion of the State of nia, and in the near future these cities will have within their borders half a million of people. They must have water. The San Leandro, San Pablo and Pinole Creeks, all combined, are not sufficient for that purpose for any long period,nor is the water to be derived therefrom of as good quality as that taken either from Alameda Creek or from the Niles Cone. Alameda Creek and Calaveras Creek are the natural water supply of the communities on our side of the bay of San Francisco and very soon will constitute the only sufficient supply. This is true whether the water is taken from the gravel bed at Niles or higher up the stream.

The Spring Valley Water Works for more than forty years has furnished water to the inhabitants of San Francisco. Nearly thirty years ago the city of San Francisco employed engineers and caused investigations to be made looking to the acquiring of water by the municipality, sufficient in quantity for many more years to come. These engineers, after examination, reported that the Spring Valley Water Works owned the sources of supply of water on the peninsula, but that Alameda Creek and Calaveras Creek could furnish all the water needed by the city for an indefinite time in the future. As soon as the report became public the Spring Valley Water Works, for the purpose, no doubt, of heading off the acquisition by the city of San Francisco of its own water supply, and also, in all probability, for the purpose of heading off any competing corporation, purchased sufficient of the water rights on Alameda Creek and in Calaveras Valley to control that source of supply. The result was that the city of San Francisco abandoned its purpose and the Spring Valley Water Works has ever since continued to furnish its inhabitants with water. That corporation actually did nothing toward utilizing the waters of Alameda Creek for many years, but about fourteen years ago, instead of utilizing the supplies it already owned on the San Francisco peninsula, but which had not been brought into use, viz: Pescadero, San Gregorio and Butano Creeks, it began elaborate works for diverting the water from Alameda Creek and from Alameda county to the San Francisco side of the bay. In

our opinion it was good business policy for the Spring Valley Water Works to do just what it did in the premises, but as a matter of fact there was no real necessity to go outside the peninsula of San Francisco to get water for the inhabitants of that city.

In prosecuting its work in Alameda county it was necessary in certain cases, to bring suits against the owners of land on the banks of the Alameda Creek to condemn their riparian rights. In all such actions the first thing requisite to prove is that public necessity requires the taking of the property in dispute for public use. The first thing, therefore, that the Spring Valley Water Works was required to prove in the suits brought by it was that public necessity required the diversion of the waters of Alameda Creek to San Francisco. But a test of that question, viz: does public necessity require the diversion of the waters of Alameda Creek for the use of the inhabitants of San Francisco, was carefully avoided, as we are informed, in every case tried in the courts. In those cases it was shown that the owners of riparian rights had received some money on account from the Spring Valley Water Works, or had made agreements relating to other lands than those in dispute with the Spring Valley Water Works, and therefore it was contended that the owners of the land were estopped from raising the question of public necessity. Our courts held in every case with the Spring Valley Water Works on that proposition, and therefore the question as to whether or not it was necessary, in order to secure a sufficient supply of water, for the city of San Francisco, for the Spring Valley Water Works to come to our side of the bay and take the waters of Alameda Creek, has never been judicially determined. If there were no sufficient supply of water on the San Francisco side of the bay, and there was enough on the Alameda side of the bay, irrespective of Alameda Creek, for the people of Oakland, Alameda and Berkeley, then there can be no doubt that the law of eminent domain could be invoked for the purpose of condemning the waters of Alameda Creek for the use of the inhabitants of San Francisco. But if there is water enough capable of utilization on the San Francisco side of the bay to furnish the inhabitants of that city with an abundance, as we believe can be shown, then neither San Francisco nor any corporation supplying it with water, can come to the Alameda side of the bay and carry away the only supply of water adequate for the needs of the inhabitants of Oakland, Alameda and Berkeley. We go even further and maintain that no corporation has a right to take the water necessary for our existence, unless there is absolutely no other way for the metropolitan city to get water. If there is not water on the peninsula for San Francisco she can obtain abundance in Santa Clara County or by going to the Sierras.

It might also be a question, in case there is not sufficient water available for San Francisco, and likewise not enough for Berkeley, Alameda and Oakland outside of Alameda Creek, whether the last named cities do not have a prior right for their own supply from the waters of Alameda Creek before there can be any diversion to San Francisco. Our people can no more live without water than any other. We must have it. It is absolutely essential, not only to the pros-

perity but even to the continued existence of the communities on this side of the bay, and it cannot be tolerated that our only sufficient source of supply should be taken from us by a corporation to sell to another city. And the case is made much worse when the large amount of water furnished by Pescadero, San Gregorio and Butano Creeks, and other streams on the same side of the bay, are not utilized for the purpose of supplying San Francisco, or, if they are not sufficient, that that city does not avail itself of Coyote Creek or other creeks in Santa Clara County, or bring this necessary of life from the high Sierras.

Section 1240 of the Code of Civil Procedure provides what property may be taken for public use, and by subdivision 3 it is declared that there may be taken "property appropriated to public use; but "such property shall not be taken unless for a more necessary pub- "lic use than that to which it has been already appropriated."

We understand that this Section of our Code is a statement of a general principle of the law of eminent domain. Taking into consideration all the conditions of water supply for San Francisco, Oakland, Berkeley and Alameda, can there be any more necessary use for the waters of Alameda Creek than giving life to the great communities for which this creek is the natural supply?

We therefore advise that Oakland may, by judicial proceedings, if no satisfactory arrangement can be made by contract, condemn such of the property of Spring Valley Water Works as may be necessary to give us water. If there is a question as to whether we should have a right to condemn and appropriate the water to the extent already diverted for use to San Francisco by the Spring Valley Water Works, there can be no question that the waters not already actually in use and which include all of the storm waters on the Alameda and Calaveras water sheds may be condemned.

## CONCLUSION.

As the result of our investigations your committee is of opinion that the city of Oakland should take into its own hands the supplying of its inhabitants with water and that the best source of supply this side of the Sierras is that to be found in the Niles gravel bed.

We therefore recommend the construction of an adequate distributing system, the laying of pipe lines to Niles, the purchase from the owners of land on this gravel bed of the right to develop and carry away water for our use, and the construction of pumping plants thereon. Proceedings in the courts should be instituted in all cases where the owners refuse to take fair compensation for their property. We do not believe it necessary to purchase the water rights of a large amount of lands on these gravel beds, but experience will be the best test as to the quantity necessary to give the city all the water it needs.

Your committee, in anticipation of a probable rise in the asking prices of lands from which water may be taken, has already secured options upon certain lands, which options will be assigned to the city as soon as proceedings are instituted for securing water from those gravel beds. These options have been secured upon the

advice of engineers that the lands covered by them are the most suitable for water development.

If it is said that the question is before the Supreme Court as to whether the owner of land in which there is a supply of percolating water can take the water from the underground reservoir for the use of a city, our reply is that until the recent decision of Katz v Walkinshaw, the Supreme Court of this State has uniformly held that underground water percolating through the gravel belongs to the owner of the land and he could do as he pleased with it, and similar decisions have been rendered by the highest court of most of the states of the Union. The opinion in the case referred to was written by the late Mr. Justice Temple, but the Supreme Court has granted a rehearing therein, and it is not at all probable that the original opinion will be sustained, as it is in conflict with repeated prior adjudications of our Supreme Court. That tribunal will very soon finally dispose of the question. If, however the remote contingency occurs of the doctrine announced by Mr. Justice Temple being affirmed by the court, then Oakland will have to settle with all of the owners of land affected in any way by withdrawing water from this underground reservoir. If the amount of the damage done cannot be agreed on the courts will fix them in condemnation suits.

The Contra Costa Water Company joined in the petition to the Supreme Court for a rehearing in Katz v Walkinshaw, for if the court should affirm that case, then, of course, the pumping from the Dingee wells can be enjoined, unless the Contra Costa Water Company pays the owners of the property covering the gravel bed. The ultimate expense is, therefore, bound to come back upon Oakland if these water rights must be purchased whether it buys its water from the Contra Costa Water Company or owns its own plant.

It must not be overlooked, in considering what should be paid to the owners of land covering the Niles Cone, that if it should turn out from actual test that the Spring Valley Water Works can cut off the inflow into the gravel bed, then these property owners will have no water to sell, for they have already sold their riparian rights to the Spring Valley Water Works, giving to that corporation the right to impound and divert all the waters of the creek. The city of Oakland has, however, the right, in order to get water for its inhabitants, to condemn all the water of Alameda Creek over and above the usual daily flow now diverted by the Spring Valley Water Works. And we believe the city of Oakland may acquire by condemnation, as a "more necessary public use," the water now being diverted to San Francisco.

It is the opinion of competent engineers that the lands between Niles and the bay, and covering this cone, will not be affected at all by pumping out the water from the gravel beds below, or by shutting off the inflow from Alameda Creek. They say the only possible effect will be to lower the wells bored into the gravel beds, but as this water is only used for domestic purposes, and can only be used for domestic purposes of the farmers living on the land, except in

the case of the Contra Costa Water Works and some manufacturing establishments, the amount of damage that Oakland would have to pay would undoubtedly be small.

By resorting first to the gravel beds for water we may avoid conflict with the Spring Valley Water Works, for we may be able to get all we need from these gravel beds notwithstanding anything the Spring Valley Water Works may do. But in the event that the inflow of water to the Niles Cone is shut off, the ownership by Oakland of a distributing system and a pipe line to Niles will be of great advantage, because the city then will be in a position either to make a favorable contract with the Spring Valley Water Works, or to proceed by condemnation to acquire a sufficient supply of water from Alameda Creek for our needs. As a larger amount of water can be obtained from Alameda Creek and Calaveras Creek than is necessary at present for the use of the people on this side of the bay, there is no reason in law, nor objection from a business point of view, to the city of Oakland entering into a contract with the Spring Valley Water Works whereby the last named corporation shall undertake to supply, at or near Niles, water at a satisfactory rate per million gallons per diem, to be diverted at that point into the water works and distributing system belonging to the city of Oakland. If the city of Oakland insists upon its rights we have no doubt that a reasonable arrangement, fair to the Spring Valley Water Works and fair to our city, can be made for diverting water at Niles from Alameda Creek for the use of our people. And in case that an arrangement by contract cannot be made with the Spring Valley Water Works we have no doubt that the courts will uphold the people of Oakland in their right to condemn and appropriate the waters of Alameda Creek as against any claim that may be set up by the Spring Valley Water Works. That corporation should be notified, and so should the people of San Francisco, that the cities on this side of the bay intend to assert their rights to the waters of the two streams spoken of whenever that water becomes an absolute necessity for our use. All future expenditure made by the Spring Valley Water Works in developing or impounding the waters of those two creeks should be with full notice that Oakland, Berkeley and Alameda know their rights in the premises and will enforce them.

Before concluding our report we desire to add that the time may come when it will be to the interest of all the people about the bay of San Francisco, including San Francisco, San Jose, Oakland, Alameda and Berkeley, to bring from the Sierras enough water to meet the needs of all their inhabitants. Whenever concerted action can be taken in that direction by the cities named a cheap and abundant supply of as fine water as there is in the world can be obtained. The first cost of undertaking, however, is so great that even the largest of the cities named will not, probably, for some years to come, undertake it on its own account unaided by its sister cities. But it is altogether probable that private capital will, in the near future, utilize the waters of one or more of the rivers flowing down the western slope of the Sierras for generating

electric power, and then, after using it for that purpose, conduct the water to the bay of San Francisco for use of the inhabitants of the different cities about it.

## COST.

We believe the accompanying estimate of City Engineer F. C. Turner, being $2,751,000, for everything except Water Rights and necessary Real Estate outside the city for pumping plants, etc., is a liberal estimate; that it is ample for the construction of a modern and efficient plant, and that he has made due allowance for present high prices of materials and labor.

We cannot make a close estimate of the cost of acquiring necessary Water Rights and Real Estate for Pumping Plants, but we do not believe it will exceed $500,000.

It is our opinion that the total cost of the entire System, including the Water, can be kept within the sum of $3,500,000.

Herewith are presented the Reports of Mr. Hering and Mr. Sanders on the Niles Cone, of Mr. Turner on a needed Distributive System, and of Mr. Miller on Wells in the city of Oakland and on the Distributive System of Contra Costa Water Company.

## THE MOST IMPORTANT REQUIREMENT.

Finally your committee desires to say that the most important requisite for securing an adequate supply of water at reasonable cost, is the election to the legislative body of our city of representative men, of character, ability, and firmness. The money for water must be raised by the issue of bonds, and our people will never vote for a bond issue until they know and have confidence in the men who must handle the large sums necessary to make the enterprise a success. There must be negotiations with able corporation managers. A weak council, however honest, cannot compete on equal terms with such men. Our representatives must know when and how to negotiate, and when and how to fight. Our city is in a difficult position, and we cannot get out of it unless we elect our best citizens to office. If we can elect an honest and capable council, all other civic good things will be added unto us.

R. H. Chamberlain,
John L. Howard,
Warren Olney,
Sol Kahn,
James P. Taylor.

OAKLAND, December 30, 1902.

To the Citizens' Committee on the Investigation of Water Supply for the City of Oakland, California.

GENTLEMEN:—You have requested me to investigate the available sources of subterranean water at Niles and vicinity and to designate the quantity which may be supplied therefrom to the city of Oakland.

For this purpose after meeting your Chairman and obtaining from him particulars, I proceeded to Hayward and went over the territory which is called the Niles Cone and from which it is sought to obtain a supply.

The next day I met your Committee and in general outlined what I believed could be done to answer your question within the limited time available. On a subsequent day I examined a large portion of the valley of the Alameda and Calaveras Creeks above the canyon through which the water of these two creeks reaches the cone at the base of the mountain range.

For the purpose at hand you have also placed at my disposal numerous maps, reports and other data bearing upon the question, all of which I have carefully examined. No special surveys, borings, gaugings or other field measurements have been made by me.

From my personal examination of the ground, from what you have furnished me, and from the experience I have gained in similar cases, I respectfully present the following report:

To maintain a constant draft of water at any locality there must be from some source a perpetual supply of at least the same quantity of water, which primary source is the rainfall upon the watershed or drainage area above the point where the draft is made. In the present case the area is the watershed of Alameda and Calaveras Creeks above Niles stated as being about six hundred square miles, and the rainfall is the precipitation upon this area.

From the rainfall Distribution Map, accompanying a Report on Irrigation and Water Supply of California, by William Ham. Hall State Engineer, I find the precipitation at various points at or near the watershed to be as follows:

| | |
|---|---|
| Niles | 16.75 inches. |
| Pleasanton | 17.23 inches. |
| Livermore | 13.71 inches. |
| Altamont | 6.85 inches. |
| Mount Diablo | 16.70 inches. |
| Mount Hamilton | 37.16 inches. |

From your Secretary I have received a statement of the rainfall gauged for twenty-two years at San Leandro Lake or Lake Chabot, from which I find the average at this point to be 22.6 inches.

Taking into consideration the extent, character and distribution of the several characteristic parts of this entire watershed, I believe that 20 inches is a fair average to assume for the mean annual rainfall upon it, a figure which is at least sufficiently close for the present purpose.

Of this rain the main part is evaporated from the surface of the ground, or disappears by being absorbed by plants. Another part visibly runs off on the surface into the creek and reaches the new dam of the Spring Valley Water Works. The remaining part of the water percolates in and through the soil until it reaches the water table, from which it is finally discharged as springs or escapes in the form of myriads of streamlets into the open water courses, creeks, ditches or into the bay.

No exact division of these parts seems to be available in this case, and I have been obliged to form my own conclusion based on similar cases in other localities, on the concentration of the rainfall over about six months of the year, on the average declivity of the surface and permeability of the soil, on the existing ground water development, and on the amount of vegetation covering the area. My best judgment would divide the annual rainfall of 20 inches into not over two and two-thirds inches of surface runoff under present conditions of development, one-third inch for ground water runoff, and 17 inches for evaporation. It is probable that the run off will be rather less and not more than these amounts.

A water supply such as we are considering is dependent upon the minimum and not on the average rainfall. A city must have an ample source at all times, and particularly in dry seasons, in order to prevent possible injurious sanitary results and danger from a large conflagration.

In view of the large underground storage which is found available at Niles, it is proper to take the minimum rainfall, not for a single year but for two low years in succession. From the Lake Chabot records we have the following:

1884–85.....12.92 inches.
1885–86.....20.35 inches.
1886–87.....15.43 inches.
1887–88.....14.59 inches.
1888–89.....17.05 inches.

We have also the following Mount Hamilton observations:

1887–88.....17.66 inches
1888–89.....25.73 inches.

For these two periods of drought I do not think we should assume an annual average for the entire watershed in question of more than 15 inches which in my opinion would be a liberal allowance.

The foregoing division of the rainfall into evaporation and runoff, when referred to this small rainfall, would, in my judgment give not over one and three-fourths inches for the surface runoff, one-fourth inch for the ground water runoff, and about 13 inches for evaporation. I even feel sure that a year might occur when the rain would fall in such light quantities that the total combined runoff might be reduced to one inch instead of two inches, precedent for which have occurred in this neighborhood.

The Spring Valley Water Works through their position have at present the prior right to the two inches and respectively one inch

of rainfall per annum which a dry year would furnish. But their present works are not capable of taking away more than about two-fifths of one inch of rainfall. If two inches of rain are available, then, after deducting what they remove, one and three-fifths inches remain; if but one inch is available, but three-fifths of an inch remain. The question now arises as to how much of this remainder can be secured for the present purpose.

I am well satisfied, and this opinion is confirmed by Prof. A. C. Lawson of the University of California, that no ground water in any appreciable quantity percolates through the rocks of the mountains separating the watershed of the Alameda Creek above the Spring Valley Water Works dam into Niles Canyon to the plains below. Whatever water is available below must pass over this dam or be supplied by the rainfall upon the plains themselves. Regarding the value of the latter during a dry year, the quantity would hardly be appreciable, on account of both the smallness of the area and the clay soil covering a large part of it, which would tend to cause a more complete runoff, and after finding its way into the creeks would become unsuitable for a domestic supply.

We are therefore confined to the consideration of the water which flows over the Spring Valley Water Works dam, or, in the usual term, is wasted after this corporation's conduit is filled.

The water from a two-inch runoff on six hundred square miles is 2,787,840,000 cubic feet, or 20,908 million gallons per annum or say 57 million gallons per day, uniformly distributed as to time. Deducting the quantity withdrawn by the Water Works, let us suppose it to be the present maximum of ten million gallons, we still have a theoretical average overflow during a dry year of 47 million gallons per day or 17,258 million gallons per annum.

To utilize this water, as much of it as practicable must be held back and temporarily stored, and not discharged into the San Francisco Bay as at present by the surface and underground flows. The Niles Cone has been suggested for this purpose, which is an accumulation of gravel and sand deposited ages ago by the Alameda Creek after it emerged from the canyon and emptied its waters upon the plains. The material is very porous and at present readily yields large supplies of water. Many wells have been sunk into it. Some of which are said to yield a thousand gallons per minute.

The surface of the ground water slopes from the canyon to the bay. Usually the slope in such material ranges from three to six feet per mile varying with the quantity of flow, the greater slope being found in wet weather. In dry weather the level of the ground-water at Niles should therefore be much lower than in wet weather, while there can practically be no difference near the bay.

I have examined the character of this gravel, both in place at the creek and after it has been excavated from near the surface. If the gravel maintains this character throughout its bed, I should say that from one cubic foot it was practicable to withdraw a quantity of water equal to one-sixth of a cubic foot. At its best, one-third of

the content of such gravel consists of voids which may hold water. The sizes of the grains in this case, however, are quite irregular, which reduces the void content, and besides the capillarity will not allow all of the water to be withdrawn. Therefore one-sixth of the total mass, is, in my opinion, about the proper figure here to allow. This reasoning holds good in the case of sand as well as gravel. In the former the water is withdrawn less rapidly, and therefore requires more frequently placed wells and finer strainers than gravel.

I am informed that there are at least six square miles over which this gravel extends. One square mile having 27,878,400 square feet of surface, can therefore store 4,646,000 cubic feet of usable water for every foot in depth. Therefore to withdraw daily one million cubic feet or 7,500,000 gallons, or annually 2,737 million gallons from this area, without any replenishment, we need about 13 feet of depth. Or, we could withdraw daily 15 million gallons, or annually, 5,475 million gallons, by drawing the water from the gravel to a depth of about 26 feet. The gravel at some places extends to a very much greater depth. Whether this depth is equally great over the entire six square miles I have no evidence, but the indications favor a depth more than sufficient for the present purpose. In fact the available storage capacity seems to be so large that a uniform daily draft can not be affected even by a very irregular replenishment of the water.

It is therefore clear from the data that have been given me and from my own examinations, that the Niles Cone has different storage capacity to furnish a daily supply of 15 million gallons throughout a whole year without any replenishment whatever from Alameda Creek during this time.

We have now to examine into the important connecting link between the delivery of the water over the dam above Niles, and the storage of the same in the Niles Cone.

It has been concluded above that under present conditions of development there may be 47 million gallons of water per day or 17,258 million gallons per annum wasting over the Spring Valley Water Works' dam in dry years, with a remote possibility that occasionally there might be perhaps but one-half this amount, or even still less. It has also been found that the storage capacity of the Niles Cone is sufficient to withdraw therefrom daily 15 million gallons, or annually 5,475 million gallons for one whole year without any replenishment whatever.

The limits for the present problem of a perpetual supply lie in the transfer of the present flood waters of the creek to the gravel beneath, which transfer should be sufficiently rapid to utilize as far as possible the full capacity, both of the available source of water and of the storage reservoir.

The only local facts that seem to be available for the purpose of throwing light upon this question, are certain gaugings made by George F. Allardt, C. E. and which are obtained from testimony he gave in this city on January 18th, 1901. He reports that his gaug-

ings on December 17th, 1896 showed a loss of water by percolation into the gravel underlying the creek between Bed Rock Dam and Bell Ranch Bridge of 27,580,000 gallons per day, but that the water in the river on that day was spreading over only one-sixth of the width of the entire bed.

From this and other information he makes an estimate of the amount of water, which, during the rainy season, would percolate into the gravel between the above points. After determining the average number of rainy days in the winter to be 48, he concludes that during these days there would filter into gravel from the creek 7,189 million gallons, or about 150 million gallons per day.

From an entirely independent but competent source I have received an estimate that the percolation from the creek has been at the rate of about 100 million gallons per day; for 48 days this would give 4,800 million gallons as filtering into the gravel during this time.

The average daily flow of the creek during the time when Mr. Allardt made his estimate, is stated by him to have been about a thousand million gallons. He also reports that below the Niles Bridge the creek becomes dry soon after the cessation of rains and remains dry all summer, and gives it as his opinion that in the dry year of 1887 to '88 the total amount of water passing over the Water Works' dam for one year, after deducting the amount diverted into the conduit, was about 6,981 million gallons. I have no reason to question these deductions.

As the rate of consumption of 15 million gallons per day, would require a draft from the Niles Cone of 5,475 million gallons per annum, it appears, assuming Mr. Allardt's deduction to be correct, that during the single dry year of 1887–88 there would have been enough infiltration to replenish the entire amount withdrawn. Assuming that the rate of infiltration had been only one hundred million gallons a day for 48 days, there would have been a partial withdrawal of the storage reserve of only 675 million gallons, a small amount compared with the total reserve, not to speak of the infiltration during the remaining part of the year.

In the practice of water and sewage filtration through gravel and sand, a large experience has been gained with the rates at which water will pass through porous materials. The character of sand best suited for such purposes might be popularly characterized as equal to that of good mortar sand. The rate of percolation of average river water for the present purpose through this material may be taken at four million gallons per acre per day, providing the surface sand was kept in a fairly clean condition, which the flowing water of the creek, and some special attention could accomplish. A coaser material would allow of a greater rate of filtration.

Applying this conclusion and assuming that the length of the gravel bed in the river from Bed Rock Dam to Bell Ranch Bridge is 30,000 feet and its average effective width is 50 feet, the area for filtration would be about 35 acres. Taking a rate of filtration of but four million gallons per acre per day, we would have a percolation

of 140 million gallons per day, which practically confirms Mr. Allardt's deduction from his measured flows.

It should be repeated, however, that this rate, if continued indefinitely, means the necessity of preventing the surface of the bed from eventually clogging by filling up of the interstices near the surface with clay or silt brought down by the turbid waters of freshets. To prevent this occurrence no other difficulty except careful attention and an occasional taking over of some parts of the surface should be met. The intermittant dry seasons would help materially to improve the condition.

Notwithstanding the fact that the figures which I have given contain margins of safety, a supply drawn from the Niles Cone would necessitate careful attention to all the conditions affecting it, so as to conserve the available water to the greatest practicable extent. The figures apply clearly to the entire output of water which is now available, and not to conditions following any changes that could affect the present flow over the Spring Valley Water Works.

There is another, but much smaller source of supply of the same character which could be obtained in the same way, situated along the conduit line which would connect the Niles Cone with your City. Where the San Lorenzo Creek issues from the mountains there is also a well marked Cone of the same gravelly character as the Niles Cone, and it would probably yield at least from one to two million gallons daily, during the driest season, judging from the extent and character of the area supplying it with water.

You have asked me to state my opinion regarding the advantages of using a subterranean source of water for a city supply. It has been held for some time in Europe and recently also here, that there are but two sources of water supply for a modern community which are safe from a hygienic and acceptable from an æsthetic standpoint. These sources are naturally filtered water, otherwise known as spring, well or groundwater, and artificially filtered river or lake water, such as is furnished in a number of European cities and now is being introduced in our own country. All other sources are gradually being considered either objectionable or open to suspicion on account of their unprotected and exposed condition. Between the two acceptable sources preference is given in Europe to the groundwater wherever available and practicable, for the reason that, with safeguards easily obtained, the process of purification is conducted by nature according to definite, fixed laws, and removed from any possible carelessness or ignorance on the part of those operating an artificial filter. If the ground or spring water is free from surface or mineral pollution, no objection can be made to it, and it has been in fact always the favorite water for mankind.

In the above discussion nothing has been said concerning the details of pumping required to take the water at a suitable and safe level at times both of plenty and of drought, nor of the most suitable location on this cone for the extraction of the water. Further, the opinions and conclusions advanced have reference to the engineering standpoint alone, and are independent of any legal or prop-

erty right questions that might arise in the carrying out of this project.

Briefly to sum up the conclusion, it can be said, that the storage capacity of the Niles Cone, the quantity of water now flowing over the Spring Valley Water Works dam and naturally percolating into this Cone from the river bed, are together sufficient to assure a safe permanent draft of water below Niles of 15 million gallons per day.

Respectfully presented

( Signed ) RUDOLPH HERING.

To the Citizens' Committee on Water Supply of the City of Oakland, Alameda County, Cal.

GENTLEMEN:—

Agreeable to your request made at the time of my recent visit to your City, I present the following report upon the water supply of the Niles Cone and vicinity.

The investigation will be considered under the following heads:

I. Rainfall.
II. Watershed.
III. Runoff?
IV. Storage capacity of Cone and Vicinity.
V. Draft on Cone.

## I.

## RAINFALL.

Statistics show that the average rainfall for San Francisco for 47 years was about 23 inches. I believe the conclusion is fully warranted that the rainfall on the entire area of the watershed under consideration, will average at least as much as the rainfall in the City of San Francisco.

## II.

## WATERSHED.

The area of the watershed tributary to the Niles Cone is, approximately, 600 square miles and the Alameda Creek, with its tributaries, is the principal drainage stream.

At the point where it debouches from the mountains, the elevation is about 100 feet. The detritus from the mountains forms a cone with the apex above the Niles Bridge, but below the Springs Valley Water Works' dam, and spreads to the south and west in the form of a fan, the axis of the cone lying in about a straight line from the Niles Bridge to Centerville. The western part of the cone verges into another cone, which I designate as the Haywards Cone, somewhere near Alvarado.

The cones are built up of boulders and gravel carried out of the canyons by floods, the coarsest material being deposited near the canyon, the finer being carried farther away, thus forming a series of porous strata at different elevations. Through these series of porous strata the underflow of water passes or is retained, forming an underground reservoir as shown in the Allardt and Browne Profile and Map.

## III.

## RUNOFF

The runoff is a much more difficult problem to solve. The most reliable basis of estimate is found in the measured runoff for a series of years, but if that is not to be obtained, as close an estimate as possible may be made from other streams in the district whose flow is known.

LeConte estimates that in the vicinity of San Francisco when the yearly rainfall is 10, 20, 30, 40, or 50 inches, the runoff is approximately .05, 2, 9, 18 and 30 inches respectively.

Schuyler's work on Reservoirs for Irrigation, etc., p. 203, says: "The average precipitation over all the Spring Valley Water Works sheds during the seven years from 1868 to 1875, was 43 5-10 inches from which the mean runoff was 35 5-10, per cent, including loss by evaporation. These watersheds are partly wooded undulating pasture lands, uncultivated, covered with deep soil, and clothed with native grasses that spring up annually from seed and have little permanent sod. The results of the measured catchment from the areas indicate, that in general terms, on watersheds of this character found 20 to 35 inches of rainfall are usually taken into the soil and absorbed in plant growth and evaporation." The above is an exact quotation from Mr. Schuyler, but it will be observed that he has omitted any estimate for percolation. He has apparently allowed for evaporation twice. It will be seen that if 35 5-10 per cent goes to runoff and evaporation, it leaves 64 5-10 per cent for plant life and percolation.

I am informed that the watershed under consideration, is, much of it, covered with a sandy porous soil. With a watershed of this character, it is safe to assume that 50 per cent or 11½ inches of a 23 inch rainfall, percolates through the soil and descends rapidly to a point beyond the reach of vegetation and augments the ground supply.

Eleven and one-half inches rainfall percolating over the watershed under consideration, gives 119,926 million gallons, which represents, on this basis of estimate, the amount of water that enters the ground and becomes the ground supply.

The total watershed of 600 square miles with 23 inches rain fall gives 239,852 million gallons.

The Le Conte estimate of runoff for this amount of rainfall would be 4 1-10 inches, equal to 42,756 million gallons, leaving 197,096 million gallons for plant life, evaporation and percolation. Allowing 50 per cent of above (or 41 per cent of total rainfall) for percolation, gives 98,530 million gallons replenishment to the ground supply.

If these assumptions are right for runoff, plant life and evaporation, it is self evident that the ground supply, or percolating water must find an outlet through a previous stratum to the lower levels.

From the Niles Bridge to a point 1 ½ miles farther down the creek, the Allardt measurements showed a percolation or disappearance from the surface flow of 24 million gallons, (stream width 60 feet).

This reaches the ground water of the Niles Cone and is readily perceived, after a dry period, in the raising of the level of the wells near the channel of the creek.

To the question propounded by the Committee—"The effect of a large diversion of water in the Niles Canyon?"—I reply that it would undoubtedly affect the flow or runoff below the bridge, thereby decreasing the replenishment of the cone, in so far as its replenish ment is supplied by stream flow below the point of diversion. But inasmuch as my experience in Southern California shows that

quite a large proportion of the rainfall on watersheds does not appear in the surface flow at the mouth of the canyon and is not accounted for in loss by plant life and evaporation, therefore I conclude that the water otherwise accounted for must find a subterranean outlet.

The percolation of ground water is downward and all authorities agree that it is towards a stream, lake or sea, and that the water will seek the lowest accessible channel.

In the watershed under consideration the natural inference would be that it percolates towards these gravel beds, being the nearest accessible outlet. If this water did not find some outlet the soil would be surcharged with water over a considerable area of the low lying lands of the watershed.

## IV.

## STORAGE CAPACITY.

From the Profile Maps of Ross E. Browne and Allardt, I estimate the storage capacity of the cone at 17,595 million gallons. I consider this a very conservative estimate. This amount is on a basis of 40 feet as the average depth of gravel above sea level.

Instances are found in the section being considered, where ground water is pumped from a point fifteen or more below sea level, the quality being found perfectly satisfactory, and there is without doubt, in the area now under consideration a very large amount of available water-bearing gravel lying below sea level. You will observe, however, that my estimates do not take any of this water into account.

## V.

## DRAFT ON CONE.

About 30 per cent of this 17,595 million gallons I place as that maximum draft for the cone by a series of wells. Reliable data would indicate that of water pumped from this gravel bed or cone for irrigation purposes, from 40 to 60 per cent finds its way by percolation back to the gravel bed.

The amount obtainable by wells from any stratum may be predicted by comparison with wells bored to the same strata. I am informed that wells in that vicinity are pumped and 250,000 to one million gallons daily are obtained from separate wells.

While the total quantity of water is generally increased by additional wells, the flow is not as great as the sum of the separate wells and a point is reached where the increase in quantity is not commensurate with the cost of development.

The fact, however, that the water level in the wells of the Sugar Company at Alvarado has lowered since the operation of the so-called "Dingee Wells" does not, in my opinion, indicate any considerable lowering of the general ground water level but merely that such level, within what is technically known as "the circle of influence" has been lowered.

## CONCLUSION.

I am convinced that the City of Oakland would make no mistake in selecting, as its source of supply, the Niles Cone. I believe that source to be thoroughly reliable, and I suggest the acquisition by the city of various tracts, considerably scattered within this general water-bearing gravel area.

Trusting, gentlemen, that I have covered the several parts of the subject presented by you for my consideration, I am

Very respectfully,

(Signed) W. H. SANDERS,
Consulting Engineer

Pomona, Cal., December 20, 1902.

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OAKLAND, January 5, 1903.

The Citizens' Water Committee,
Oakland, California.

GENTLEMEN:—

As requested by you I submit herewith an estimate of cost of a new Water Works System for the City of Oakland. It is based upon testimony given by expert engineering witnesses in the so-called Water Rate Suit, with such changes in prices and such additions as are required for present conditions according to my own judgment. While only a preliminary estimate and somewhat general in its character it is believed to be very liberal and to allow an ample margin for contractors' profits and contingencies.

Notes explaining a little more in detail are attached hereto, and also a complete estimate for a similar plant given by one of the witnesses in the Water Rate Suit. The capacity of the plant is 13,000,000 gallons per day. Summarized the estimate is as follows:

| | |
|---|---|
| Two pumping plants at $150,000 | $ 300,000.00 |
| 91,121 feet of 37½ inch conduit pipe of No. 6, wrought iron, including, cost of laying and cost of gates | 537,000.00 |
| Distributing system, including real estate, inside the city, distributing reservoirs, and 14.000 meters; also an addition of $164.000 for use of cast iron mains, instead of sheet iron, for sizes between 14 in. and 24 in. inclusive | 1,834,000.00 |
| Interest during construction | 80,000.00 |
| Total, exclusive of water rights and lands outside the City of Oakland | $2,751,000.00 |

Very respectfully,

(Signed) F. C. TURNER,
City Engineer.

## DISTRIBUTING SYSTEM.

| | | |
|---|---|---|
| Pipe system as estimated by Messrs. Moore and Marx in 1900 | | $1,076,178.00 |
| Addition of 10 per cent for increased prices at present | | 107,618.00 |
| Pipe system of Messrs. Moore and Marx, 1902 | | 1,183,796.00 |
| Distributing reservoirs, including real estate | | 100,000.00 |
| High service pumping plants, shops and tools | | 35,000.00 |
| Additional hydrants—200 at $45.00 set in place | | 9,000.00 |
| " services—5,000 at $9.00 | | 45,000 00 |
| Small service mains (2-in)–150,000 ft. at 25c, including gates and fittings, and laying | | 37,500.0 |
| Stock on hand, pipe fittings and extra parts | | 25,000.00 |
| Additional for cost of re-paving trenches | | 25 000.00 |
| Meters | | |
| 7,720–5-8″ at $12.00 set in place | $92,640.00 | 210,000.00 |
| 5.000--3-4″ at $16.00 set in place | 80,000.00 | |
| 1,000-- 1″ at 20.00 set in place | 20,000.00 | |
| 200--1 1-2″ at 35.00 set in place | 7,000.00 | |
| 50--2″ at 57.50 set in place | 2,875.00 | |
| 20--3″ at 100.00 set in place | 2,000.00 | |
| 10--4″-\|- at 250.00 set in place | 2,500.00 | |
| | $207,015.00 | |
| Add for extras and tools, etc. | 2,985.00 | |
| | $210,000.00 | |
| Total | | $1,670,296.00 |
| Or in round numbers | | $1,670,000,00 |
| To use cast iron mains instead of sheet iron between sizes of 14 in. and 24 in., inclusive, add $164,000, making a total cost | | $1,834,000.00 |

## CONDUIT PIPE.

Diameter 37½″. Length of Alvarado conduit, as used by Prof. Marx—91,121 feet. Material No. 6 wrought iron. The size of 37½″ is that used by Messrs. Marx and Moore for their proposed new plant.

Cost per foot—estimated from present prices:

| | |
|---|---|
| Pipe in lengths at works, San Francisco | $4.35 |
| Freight, teaming and handling at $5.00 per ton | .25 |
| Trenching and back filling | .35 |
| Laying additional to above approx | .25 |
| Extra work-bridges, hills, macadamized roads, etc., average | .10 |
| Total per lineal foot | $5.30 |
| Total per mile | $27,984.00 |
| In round numbers | $28,000.00 |

| | |
|---|---|
| Cost of conduit, 91,121 ft. at $5.30 per foot ..... | $482,941.00 |
| Extra for underpinning in marsh ground near wells.. | 5,000.00 |
| | $487,941.00 |
| Add 10 % for contingencies and incidentals..... | 48,794.00 |
| Total ..... | $536,735.00 |
| Or in round numbers ..... | $537,000.00 |

## PUMPING PLANT

Cost of Alvarado pumping plant:

| | | |
|---|---|---|
| City's Witnesses. | Marx ..... | 106,366.00 |
| | Riffle ..... | 109,941.00 |
| | Allardt ..... | 101,145.00 |
| | Hicks..... | 106,399.00 |
| | Fish, 60,795 for machinery etc., 28,000 for wells, added... | 88,795.00 |
| | Hall ..... | 115,483.00 |
| | Miller..... | 115,531.00 |
| | | $743,660.00 |
| Average ..... | | $106,237.00 |

| | | |
|---|---|---|
| Water Co.'s Witnesses | Adams ..... | $124,000.00 |
| | Schuyler ..... | No estimate in detail. |
| | Kiersted ..... | No estimate in detail. |

Average between City's witnesses and Water Company's witnesses, $115,118.00—original cost approx.

Add 30 % as increase in prices, average on whole, $34,535.40. $149,653.40, or in round numbers. $150,000.00.

For two plants, each equal to the present Alvarado plant exclusive of real estate, $300,000.00.

NOTE.—This is a liberal estimate, but I had no time to get present prices in detail. Machinery has made a great advance since the works were built and I assumed 30 % on the whole.

## MARX AND MOORE ESTIMATE OF 1900

Estimate for proposed Distributing (pipe) System in Oakland, of equal efficiency, as Combined Contra Costa and Oakland Water Companies, or for 13,000,000 gals per day

| Diameter Pipe | Material | Length in feet | Price per foot in cents | Total Cost |
|---|---|---|---|---|
| 3″ | Cast iron | 122,000 | 53.2 | $ 64,904.00 |
| 4″ | " " | 458,000 | 61.3 | 280,754.00 |
| 6″ | " " | 129,000 | 88.3 | 113,907.00 |
| 8″ | " " | 56,800 | 118 | 67,024.00 |
| 10″ | " " | 81,800 | 162 | 132,516.00 |
| 12″ | " " | 19,300 | 208.7 | 40,279.10 |
| 14″ | Sheet–12 gauge | 4,100 | 122.7 | 5,030.70 |
| 15″ | " 12 " | 5,000 | 131.5 | 6,575.00 |
| 16″ | " 10 " | 9,200 | 160 | 14,720.00 |

| | | | | | |
|---|---|---|---|---|---|
| 18″ | Sheet | 10 | gauge | 2,700 | 169 | $ 4,563.00 |
| 20″ | " | 8 | " | 10,400 | 203 | 21,112.00 |
| 24″ | " | 8 | " | 33,400 | 232. | 77,488.00 |
| 30″ | " | 6 | " | 15,150 | 352 | 54,328.00 |
| 37½″ | " | 6 | " | 450 | 415.5 | 1,869.75 |
| | | | | | | $885,070.55 |
| Add 10%, Engineering and contingencies ..... | | | | | | 88,507.00 |
| | | | | | | $973,578.00 |
| (2,800 + 6,200)=9,000 services at $8.00 | | | | | | 72,000.00 |
| 260 single hydrants at $30.00 ..... | | | | | | 7,800.00 |
| 70 double hydrants at $40.00 ..... | | | | | | 2,800.00 |
| Replacing McAdam pavements ..... | | | | | | 20,000.00 |
| Cost of proposed distribution system complete exclusive of conduits ..... | | | | | | $1,076.178.00 |

Estimate based on cast iron for 3″ pipe at $45.00 per ton, larger sizes, $40.50.

| | | | | |
|---|---|---|---|---|
| Rivetted | pipe | 14″ to 16″ | at | $4.25 per lb. |
| " | " | 18″ to 22″ | at | 4.00 per lb. |
| " | " | 24″ to 30″ | at | 3.75 per lb. |
| " | " | 37½″ | at | 3.50 per lb. |

---

NOTE.—Above made for Water Rate Suit. Only the total of $1,076,178 is in evidence. The details were obtained by writing to the witnesses, Prof. C. D. Marx and Mr. C. E. Moore, who used the same figures. The prices evidently cover cost of gates and specials, as estimate is marked complete.

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## NOTES ON ESTIMATE FOR DISTRIBUTING SYSTEM

Prices of pipe, cast iron, per ton of 2,000 pounds.
Quotations in December, 1902, f. o. b. S. F.

| Size inches | Moore and Marx in 1900 | C. Froelich | N. B. Livermore (Forecast six months ahead) | W. W. Montague & Co. |
|---|---|---|---|---|
| 3 | $45.00 | | 43.00 | 45.00 |
| 4 | 40.50 | 46.00 | 43.00 | 45.00 |
| 6 | 40.50 | 45.00 | 43.00 | 45.00 |
| 8 to 12 | 40.50 | 44.00 | 43.00 | 45.00 |

The above differences approximate 10 % increase since 1900 and as labor and other items of cost have also advanced, this percentage was added to the whole cost, and, for preliminary estimate is reasonably close. The cost of the pipe itself is far the largest item, ¾ or more of the cost in place.

## DISTRIBUTING RESERVOIRS.

Estimates of City distributing reservoirs of the Oakland Water Company were given by expert witnesses in the Water Rate Suit, and varied from $68,886 (Hicks) to $80,590 (Hall), exclusive of value of land. In my judgment it is unwise to omit having a large amount of storage inside the city limits, or near by, not only in order to benefit fire service, but as a precaution against accident to the supply conduit. The item of $100,000 is assumed by comparison with the Oakland Water Company's system in this respect, adding about $25,000 for the cost of the real estate.

## HIGH SERVICE PUMPING PLANT, SHOPS AND TOOLS.

The O. W. Co. and the old C. C. W. Co. together, according to the testimony, had only about $21,000 invested in these items in the city; but they both have supplies by gravity at elevations above the head likely to be maintained by the pumping system—economically maintained—and therefore the high service pumps must be larger. Mr. Hicks used $27,000 for pumping stations alone in 1900.

## EXTRA HYDRANTS.

You will note that the estimate of Messrs. Moore and Marx provides for 330 fire hydrants. The number in use in the City at present is 525, or 195 more. I have used the even number of 200 for the additional number to be provided.

I am informed by the Fire Department that the cost to the City for installing new hydrants is, now, about $55.95 each. I have ascertained that those in use are now the property of the City and could be connected to its own mains if its works were built; but no allowance has been made for this as the item is relatively small. A large number put in at one time by contract will cost much less than the price for single hydrants installed at intervals, and the price of $45.00, or 12½ % increase over the price used by Prof. Marx for double nozzle patterns, is deemed ample.

## ADDITIONAL SERVICES.

The number of services were estimated at 9,000 in the estimate of Messrs. Marx and Moore. The late census shows over 82,000 inhabitants and a rapid present growth. With the advent of a city supply it is probable that many people at present being supplied from their own wells will patronize the city works. For the purpose of an estimate therefore it seems to me that calculation for a service for every six people should be made, or, for 84,000 (allowing for increased population between now and the time when the works are likely to be completed) the number of 14,000 services, which would be 5,000 more than the original estimate. The price of $9.00 is 12½ % addition to that used by Messrs. Moore and Marx in 1900. Extra pipe and stock on hand, and small service mains.

Provision should be made for 2″ mains in outlying, sparsely settled regions of the city which were not provided for in the original estimates.

## METERS.

In order to keep consumption down to anything like the 75 gallons per capita used by the city's experts in their computations, the supply must be metered, and entirely metered. This is, certainly, the most reasonable and equitable mode of charging for service, provided it is done alike to all.

The prices used are about 10 % greater than the costs given in the testimony by Prof. Marx. The proportion of sizes used in the estimate is an assumption.

## RE-PAVING.

Only $20,000 was allowed for this in the original estimate. The printed report of the Superintendent of Streets in 1898 gave the mileage of streets in the city as follows:

| | | |
|---|---|---|
| Macadamized | 99.7 | miles |
| Bitumenized | 4.74 | miles |
| Wooden blocks on concrete | 0.7 | " |
| Partly macadamized | 24.34 | " |
| Unimproved | 105.36 | " |
| Total | 234.84 | miles |

Since 1898 new streets have been opened and much paving done, but no report has been published. Allowing three miles per year for new macadamizing, and .31 miles for total additional bitumen, gives 112 miles macadamized, 24 miles partly so and 5¾ miles bitumen and wooden block pavement. The Los Angeles Board of Consulting Engineers used the following prices for repaving:

| | | | |
|---|---|---|---|
| for 6″ c.i. pipe | Added for macadam 5 cts per foot or $264.00 per mile | Add for Asphalt on broken stone $1372.80 per mile. | Add for Asphalt on concrete, $2112 per mile. |
| " 12″ " " | $316.80 per mile. | $1848 per mile. | $3168 per mile. |

If we use these prices and make the assumption 1st, that the average cost of repaving in the city will be the average of the above prices for the two sizes given, and 2d that half of the asphalt, or bitumen and wooden blocks are on concrete and half on broken stone, and 3d that the 24 miles partly macadamized will equal 20 miles macadamized, and, 4th that the prices are sufficient to cover the cost in crossings, the total cost of repaving the pipe trenches will figure up to nearly $45,000 or $25,000 more than used in the estimate by Messrs. Moore and Marx.

## LARGE SIZED CAST IRON MAINS.

It will be noted that the proposed pipe system of Messrs. Moore and Marx provides for sheet iron mains of 14" and larger diameter. These are cheaper but not so durable as cast iron and the latter is advisable in my judgment, even at the increased cost up to 24" diameter. These mains (14 "to 24" inclusive) aggregate 64,800 feet out of their total of 947,300 feet, and are estimated by them to cost $129,488.70. Adding their 10 % for contingencies and incidentals, and then 10 % for increased prices this amounts to $156,681.32. For cast iron the cost of these mains would be, approximately as follows:

| | | | |
|---|---|---|---|
| 4,100 ft. of | 14 in. | at $2.50 laid | $ 10,250.00 |
| 14,200 " " | 15 in. and 16 in. | " 2.97 " | 42,174.00 |
| 2,700 " " | 18 in. | " 3.66 | 9,882 |
| 10,400 " " | 20 in. | " 4.14 | 43,056.00 |
| 33,400 " " | 24 in. | " 5.58 | 186,372.00 |
| 64,800 | | | $291,734.00 |
| | Add 10% for contingencies and incidentals | | 29,173.00 |
| | | Total for cast iron | $320,907.00 |
| | | Total for wrought sheet iron | 156,681.00 |
| | | Extra cost of cast iron | $164,226.00 |

## HICKS' ESTIMATE.

Estimate for a pumping plant, 13,000,000 gallons per day, supply to be obtained from 1¼ miles south of Alvarado. Plant to be in duplicate for emergencies. Made by Lewis A. Hicks and used in testimony in Water Rate Suit in 1900.

| | |
|---|---|
| Water supply (wells, pumps and buildings.—A series of isolated small plants, electrically driven) | $ 385,848 00 |
| Conduit—2 lines of 30-in. pipe | 491,072 00 |
| Distributing system, taken as twice Oakland Water Co.'s system | 1,173,252 00 |
| High service pumping stations | 27,000 00 |
| Reservoirs | 104,860 00 |
| Shops and stock | 118,933 00 |
| Interest during construction | 115,048 00 |
| Total | $2,416,013 00 |

Present prices would increase estimate about $250,000.00

In the original estimate were the following items, not included in the above:

| | |
|---|---|
| Capitalization of high service pumping—added | $ 116,300 00 |
| Item—not noted in my notes, but probably an arithmetical correction | 50,000 00 |
| | $ 166,300 00 |

Deterioration—deducted in original for purpose of comparison ..... $154,742 00

Pipe System Contra Costa Co. (old Company alone) after deducting pipe taken up.—Exhibit Q 3 of Plaintiff. (Given for year 1899, only in this sheet.)

| | | | |
|---|---|---|---|
| ½ in. | 301 ft. | 7 in. sheet lined | $34,193 ft. |
| ¾ in. | 5,070 ft. | 8 in. cast | 41,481 ft. |
| 1 in. | 30,561 ft. | 8 in. converse | 2,530 ft. |
| 1¼ in. | 34,701 ft. | 9 in. sheet unlined | 5,601 ft. |
| 1½ in. | 49,297 ft. | 10 in. cast | 2,608 ft. |
| 2 in. | 612,289 ft. | 15 in. sheet, unlined | 941 ft. |
| 3 in. cast | 52,119 ft. | 11 in. sheet, unlined | 12,537 ft. |
| 3 in. and 3¼ in tubes | 15,362 ft. | 12 in. cast | 18,777 ft. |
| 4 in. converse | 10,149 ft. | 13 in. sheet, unlined | 6,555 ft. |
| 4 in. cast | 154,722 ft. | 15 in. sheet, lined | 39,121 ft. |
| 5 in. sheet unlined | 7,490 ft. | 16 in. sheet | 24,550 ft. |
| 5 in. sheet lined | 85,284 ft. | 22 in. sheet unlined | 5,060 ft. |
| 6 in. sheet | 4,490 ft. | 24 in. " " | 43,328 ft. |
| 6 in. cast | 87,568 ft. | 37½ in. sheet | 30,744 ft. |
| 6 in. converse | 4,871 ft. | 48 in. sheet | 340 ft. |
| 7 in. sheet unlined | 42,861 ft. | 12 in. converse | 53 ft. |

Total ..... 1,465,702 ft.
Add Artesian Co. pipe ..... 9,616 ft.

279 ms. 2201 ft. ..... 1,475,321 ft.
Add O. W. Co. pipe in ground ..... 154 miles, 962 ft.

Total ..... 433 miles, 3,163 ft.

## PIPE SYSTEM OAKLAND WATER CO.

(Testimony of A. S. Riffle, data supplied by Water Co.'s witnesses.)

### STANDARD SCREW PIPE.

| | |
|---|---|
| ¾ in. | 2,906 ft. |
| 1 in. | 4,396 ft. |
| 1¼ in. | 110 ft. |
| 1½ in. | 180 ft. |
| 2 in. | 187,775 ft. |
| 2½ in. | 3,800 ft. |
| 3 in. | 17,330 ft. |
| 3¼ in. | 13,725 ft. |

| | | |
|---|---|---|
| Cast iron | 4 in. | 250,185 ft. |
| " " | 6 in. | 94,275 ft. |
| " " | 8 in. | 77,839 ft. |
| " " | 10 in. | 4,280 ft. |
| " " | 12 in. | 14,280 ft. |
| Terra Cotta | 12 in. | 200 ft. |

SHEET IRON PIPE.

| | |
|---|---|
| 6 in. | 6,980 ft. |
| 7 in. | 1,950 ft. |
| 9 in. | 13,889 ft. |
| 10 in. | 1,375 ft. |
| 12 in. | 2,658 ft. |
| 14 in. | 1,130 ft. |
| 16 in. | 6,660 ft. |
| 20 in. | 26,153 ft. |
| 30 in. | 91,121 ft. (conduit) |

WOOD PIPE.

| | |
|---|---|
| 12 in. | 200 ft. |
| 16 in. | 1200 ft. |
| 20 in. | 1300 ft. |

| | |
|---|---|
| 2-in. and less diameter—O. W. Co. | 37.0 miles |
| (Old) Contra Costa W. Co. system | 138.6 " |
| Total | 175.6 miles |

To the Honorable Citizens' Committee Investigating Municipal Water Supply.

GENTLEMEN:—

Pursuant to your instructions (as per verbal directions from Mr. F. C. Turner, City Engineer) I have examined the transcript of the testimony offered in the case of C. C. W. Co. vs. City of Oakland and respectfully report as follows relative to the questions which were under consideration.

First—Contrary to my expectations I found no direct testimony relative to the adequacy of the existing combined pipe system of the C. C. W. Co. Prof. C. D. Marx testified (page 4909) that the old C. C. W. Co. pipe system is entirely insufficient for the needs of Oakland.

The question of adequacy of the pipe system was discussed at length by the Engineers for the City during their private conferences, but practically no reference in detail was made to it during the trial.

The pipe schedule submitted in evidence by the Water Company shows 277.5 miles of pipe (all told) of the old C. C. W. Co. and 156.3 miles laid by the O. W. Co. as per the following detail list:

PIPE QUANTITIES, CONTRA COSTA WATER CO.

THESE QUANTITIES INCLUDE ALL PIPE IN THE GROUND, JAN. 1, 1900 AS COMPILED BY THE WATER CO., (per A. L. HEWSON.)

| Character. | O. W. Co. Total Length. | C. C. Co. Total Length. |
|---|---|---|
| ½ gal. wrt. | | 301 |
| ¾ " | 2,906 | 5,070 |

| | | |
|---|---|---|
| 1 gal. wrt. | 4,396 | 30,561 |
| 1¼ " | 110 | 34,701 |
| 1½ " | 180 | 49,297 |
| 2 black | 187,785 | 612, 289 |
| 2½ tubes | 3,800 | |
| 3 " | 17,330 | |

| Character | O. W. Co. Total Length | C. C. Co. Total Length |
|---|---|---|
| 3¼ tubes | 13,725 | 15,362 |
| 3 cast | | 52,119 |
| 4 cast | 250,185 | 154,722 |
| 4 converse | | 10,149 |
| 5 sheet No. 16 | | 7,490 |
| 5 sheet C. L. | | 85,284 |
| 6 cast | 94,275 | 87,568 |
| 6 converse | | 4,871 |
| 6 sheet 16 | 6,980 | 4,490 |
| 7 sheet 16 | 1,950 | 42,861 |
| 7 sheet C. L. | | 34,193 |
| 8 converse | | 2,530 |
| 8 cast | 77,839 | 41,481 |
| 9 sheet 14 | 13,889 | 5,601 |
| 10 sheet 14 | 1,373 | |
| 10 cast | 4,280 | 2,608 |
| 11 sheet 14 | | 12,537 |
| 12 terra cotta | 200 | |
| 12 converse | | 53 |
| 12 cast | 14,280 | 18,777 |
| 12 sheet 14 | 2,658 | |
| 13 sheet 14 | | 6,555 |
| 14 sheet 12 | 1,130 | |
| 15 sheet 12 | | 941 |
| 15 sheet C. L. | | 39,121 |
| 16 sheet 12 | 6,660 | 24,550 |
| 20 sheet 12 | 26,153 | |
| 22 sheet 9 | | 5,060 |
| 24 sheet 9 | | 43,328 |
| 30 sheet 10 | 91,121 | |
| 37 ½ 7 | | 30,744 |
| 48 | | 340 |
| 16 wood | 979 | |
| 20 wood | 1,106 | |
| | 825,290 | 1,465,554 |

The writer in conjunction with a representative of the Water Co. made scale measurements of the pipe system from the Water Co. Maps inside the City Limits and found that the old C. C. Co. had a total of 167.22 miles and the O. W. Co. 119.31 miles.

Of the former, 85.74 miles is two inches and less in diameter, divided as follows:

| | | |
|---|---|---|
| ¾ | in. pipe | 0 83 miles |
| 1 | in. pipe | 4.00 miles |
| 1¼ | in. pipe | 4.48 miles |
| 1½ | in. pipe | 8.73 miles |
| 2 | in. pipe | 67.70 miles |
| | Total | 85.74 miles |

And the O. W. Co. 23.64 miles of small pipe divided as follows:

| | | |
|---|---|---|
| ¾ | in. pipe | 0.31 miles |
| 1 | in. pipe | 0.63 miles |
| 1¼ | in. pipe | 0.02 miles |
| 1½ | in. pipe | 0.11 miles |
| 2 | in. pipe | 22.57 miles |
| | Total | 23 64 miles |

This pipe is all included in the schedule of street mains. These figures did not go in as evidence but as previously stated were the result of agreed scaled measurement by A. L. Hewson for the Water Co. and the undersigned.

It is thus seen that of the old C. C. W. Co. pipe system, inside the City Limits, 51 % is two inches and less in diameter and of the O. W. Co. pipe system 19 % is also.

J. T. Fanning, C. E., a recognized authority on the subject, states that a 4-inch water main is required to supply one fire hose stream.

Six 2-inch pipes are necessary to equal one 4" pipe under prevailing conditions. From this data your Committee can draw your own conclusions as to the adequacy of the existing pipe system.

Second—I also failed to find any direct testimony covering an estimate of the cost of a new distributing pipe system for Oakland (expressed in this particular language).

Several of the Engineers for the City were asked, while upon the witness stand, what it would cost to construct a complete distributing pipe system *equivalent* to the two existing pipe systems.

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | C. E. Moore | answered | as | follows | (page 4995) | $1,076,178 |
| 2 | C. D. Marx | ,, | ,, | ,, | (page 4895) | 1,076,178 |
| 3 | Wm. Ham. Hall | ,, | ,, | ,, | (page 6258) | 1,006,291 |
| 4 | Riffle | ,, | ,, | ,, | (page 5431) | 1,193,620 |
| 5 | M. K. Miller | ,, | ,, | ,, | (page 5555) | 1,411,799 |

While not in the evidence, the fact is these figures really were computed from and based upon plans for a new distributing pipe system. The Moore and Marx estimates do not include distributing reservoirs or supply mains. This may be true also of the Riffle and Hall estimates. The Miller estimate does include distributing reservoirs and supply main 18 miles long. Prof. Marx and Mr. Moore worked together in the preparation of all of their estimates. The following detail list of their proposed "equivalent" pipe system was not given in evidence and has just been obtained from them—

## DETAILS OF PIPE SYSTEM FOR OAKLAND, "EQUIVALENT" TO EXISTING PIPE SYSTEM.

By Prof. C. D. Marx and C. E. Moore.

| | | | |
|---|---|---|---|
| 3 in. cast iron | 122,000 ft. | 0.532 | $ 64,904 |
| 4 in. ,, ,, | 458,000 ft. | .613 | 280,754 |
| 6 in. ,, ,, | 129,000 ft. | .883 | 113,907 |
| 8 in. ,, ,, | 56,800 ft. | 1.18 | 67,024 |
| 10 in. ,, ,, | 81,800 ft. | 1.62 | 132,516 |
| 12 in. ,, ,, | 19,300 ft. | 2.087 | 40,279.10 |
| 14 in. riv. sheet iron No. 12 | 4,100 ft. | 1.227 | 5,030.70 |
| 15 in. ,, ,, ,, No. 12 | 5,000 ft. | 1.315 | 6,575 |
| 16 in. ,, ,, ,, No. 10 | 9,200 ft. | 1.60 | 14,720 |
| 18 in. ,, ,, ,, No. 10 | 2,700 ft. | 1.69 | 4,563 |
| 20 in. ,, ,, ,, No. 8 | 10,400 ft. | 2.03 | 21,112 |
| 24 in. ,, ,, ,, No. 8 | 33,400 ft. | 2.32 | 77,488 |
| 30 in. ,, ,, ,, No. 6 | 15,150 ft. | 3.52 | 54,528 |
| 37½ in. " " | 450 ft. | 4.155 | 1869.75 |
| Total | | | $885,070.55 |
| Add 10 per cent. for engineering | | | 88,507.05 |
| Add for 9,000 services at $8 | | | 72,000 |
| " 260 single hydrants at $30 | | | 78,000 |
| " 70 double " at $40 | | | 2,800 |
| " repairs to pavements | | | 20,000 |
| Total cost | | | $1,076,178.00 |

Prices based on riveted pipe 14 in. and 16 in. at 4¼ cents per lb.
" " " 18 " 22 " 4 "
" " " 24 in. to 30 " 3¾ "
" " " 37½ in. at 3½ "

No allowance made for distributing, reservoirs and supply main.

The Hall and Riffle "equivalent" pipe system details are not available.

The Miller new pipe system was designed to furnish a population of 100,000 people at a per capita rate of 100 gallons per day. Also 20 fire hose streams in the central business part of the City.

The pipe system and estimated cost is as follows:

| | | | |
|---|---|---|---|
| 3 in. cast iron | 142,500 ft. | 0.44 | $ 62,700. |
| 4 in. cast iron | 457,900 ft. | 0.56 | 256,424. |
| 6 in. cast iron | 162,600 ft. | 0.85 | 138,210. |
| 8 in. cast iron | 86,100 ft. | 1.22 | 105,042. |
| 10 in. cast iron | 55,550 ft. | 1.63 | 90,546.50 |
| 12 in. cast iron | 10,400 ft. | 2.13 | 22,152. |
| 14 in. sheet iron No. 12 | 9,950 ft. | 1.07 | 10,646.50 |
| 16 in. sheet iron No. 11 | 3,600 ft. | 1.40 | 5,040. |
| 20 in. sheet iron No. 10 | 4,800 ft. | 1.80 | 8,640. |
| 27 in. sheet iron No. 7 | 4,400 ft. | 3.05 | 13,420. |
| 30 in. sheet iron No. 6 | 9,000 ft. | 3.30 | 29,700. |
| 33 in. sheet iron No. 6 (supply main) | 95,040 ft. | 3.50 | 332,640. |
| 2 Distributing Reservoirs | | | 30,000. |

| | |
|---|---|
| Cocks, gates and specials | $ 54,838.40 |
| 61 miles service connections | 50,000. |
| 330 hydrants | 80,800. |
| Contingencies | 121,000. |
| | $1,411,799. |

Present prices for cast iron and sheet iron pipe are a trifle higher than quotations made in August, 1900, upon which the Miller estimate was based.

From the foregoing it may be stated that the cost of a complete distributing system for Oakland, including 18 miles of 33" supply main, can be constructed at the present time for $1,500,000 in round figures.

Relative to distributing reservoirs, the old C. C. Co. had but one (the Highland Park at 21st Avenue and East 30th Street) capacity, 1,500,000 gallons, elevation 216 feet. The O. W. Co. had five reservoirs, all but one of which (the Orange Street) were used essentially for storing water from Piedmont tunnels.

A new distributing system would not require more than two distributing reservoirs located at high elevations and the cost of each would range from $15,000 to $20,000 according to size and design.

Third—Relative to the rate of consumption of water in Oakland, the testimony shows that the engineers in the case all agreed substantially that 75 gallons per capita is a fair allowance under a metered system. The testimony on this point can be found as follows:

| | | |
|---|---|---|
| Riffle | page | 5443 |
| Moore | page | 4495 |
| Hall | page | 6276 |
| Miller | page | 5555 |
| Henny | page | 5648 |

Engineers Allardt, Marx and Hicks also probably gave the same testimony but in the hasty examination of the transcript it was not observed.

Engineers Moore and Marx each testified that the cost of installing 14,544 meters would be $225,000.

As I have understood the wishes of your Committee the foregoing includes the particular features of the testimony which you desired examined.

Yours truly,

(Signed) M. K. Miller.

December 27, 1902.

(Endorsed)

December 27, 1902. M. K. Miller. (Report on C. C. Co.'s Pipe System, also on cost of an adequate Pipe System, daily consumption, etc.)

To the Honorable Citizens' Committee of Oakland, Investigating Municipal Water Supply.

GENTLEMEN:—

Pursuant to your verbal instructions I have made a superficial investigation of the water supply obtained for the ground within the area of this City and respectfully report relative thereto, as follows:

A personal canvass of the entire City was made upon a bicycle and wherever a private water supply was in evidence a call was made at the premises and an effort made to secure the necessary information to fill the following prepared form:

(Except during the latter part of the canvass where general information from well driller was substituted for details from occupants of premises.)

1. Name of owner.
2. Location.
3. Elevation ground service.
4. Elevation normal water plane.
5. Elevation low water plane.
6. Diameter of well.
7. Depth of well.
8. Number of water bearing substratas.
9. Depth and thickness of such stratas.
10. Size and character of pump.
11. Capacity of tank.
12. Kind and capacity of power.
13. Daily average working hour of pump.
14. Quantity pumped daily.
15. Number people supplied.
16. Number buildings supplied.
17. Daily consumption per capita.
18. When constructed.
19. Quality of water.
20. Cost of complete plant.

In all cases a portion of this data could not be obtained. As a general rule no record of the many wells throughout the City has been preserved. Dozens of people in the City are using water from wells of which they have no knowledge whatever beyond the fact that they enjoy an abundance of good water at all times.

The well drillers themselves have kept no record of their operations. They refer from memory, with apparent accuracy, however, to the essential details of almost any well they have respectively had charge of, and considerable information has been obtained from this source. The result of the canvass is shown in the following summarized tabulation:

1. Total number of private plants in city as per canvass.. 718
2. Of which plants windmill power is used by..... 632
3. Of which plants steam, electric or gas engine power is used by..... 63
   Of which plants haud or dog power is used by .....23
4. Probable number of buildings supplied by private plants. 1436
5. Probable number of people supplied by private plants...7180

6. Probable quantity of water produced by private plants per day (based upon rate of 100 gals. per capita).....718,000
7. Probable total cost of private water plants .....$306,200
8. Total capacity of existing tankage of private plants. 3,467,000
9. Maximum and minimum depth of wells..681 ft. and 18 ft.
10. General average depth of wells about.....100 ft.
11. Number of private wells constructed since Jan. 1900.....240
12. Probable number of wells omitted from count by oversight...50
13. Probable percentage of total population supplied from private wells (approx.).....10 %
14. Value of water from private plants, per annum, as per present meter rates.....$115,310.80
15. Annual loss to water Co., 5 % interest on .....$2,306,200

A glance at the map accompanying this report, upon which is shown the approximate location of the wells included in the canvass indicates that water in considerable quantities is obtained from the sub-surface sands and gravels, throughout nearly the entire area of Oakland, which comprises some 18.8 square miles equals 12,032 acres. It is less abundant upon the higher lands north of Lake Merritt and in East Oakland than upon the lower lands nearer the bay.

The geological structure of this locality is of Pliocene character. These upper tertiary deposits consist of clay, sands and gravels in alternating layers, extending to a depth of several hundred feet along the Bay shore. The sand and gravel sub-stratas are invariably water bearing and seem to extend throughout the area under consideration, broken more or less by the undulating clay formations. It follows therefore, that there is no regularity in the depth of existing wells or in the depth and thickness of the water bearing sub-stratas.

The surface formation throughout that portion of the City south of about Twentieth street, between Lake Merritt and the Bay, consists of from 50 to 60 feet of fine sand which is saturated with water below an elevation about 10 feet under the surface. Scores of wells, from which water has been used for many years, draw their supply from this source. Immediately below this sand, impervious clay varying in thickness is found followed by water bearing gravel, sand and clay in alternate stratas. North of Twentieth street the general character of the formation consists first of a few feet of adobe thence clay to a depth of about 20 or 25 feet at which depth water bearing gravel is found. This gravel strata is usually several feet in thickness and yields an abundance of water. At 45 or 50 feet another similar gravel strata is found. At greater depths the formation is alternating stratas of clay and gravel, the latter ranging from a few inches to several feet in thickness.

In this portion of the City (between Twentieth and Thirty-sixth streets) wells 150 feet in depth are not uncommon, very few are deeper, one well at Gill's Nursery is said to be 281 feet deep and to have yielded nearly one million gallons per day when pumped by Mr. Dingee.

At Alden, ten feet of coarse gravel is found at a depth of about 25 feet, yielding abundantly. At about 50 feet in depth another

similar gravel strata is found. The wells in this locality are all shallow, probably one-fourth of this number extending only to the first gravel. In Golden Gate the same general characteristics prevail. The wells range from 18 to 150 in depth. There appears to be no failures in attempting to obtain water anywhere in this portion of the city.

In East Oakland on the lower levels, a clay formation extends from the surface to a depth of about 50 feet where several feet of water bearing gravel is found. At 90 feet, several feet additional of gravel is encountered. The stratification is not so uniform in this locality as west of Lake Merritt. Occasionally some difficulty is experienced in obtaining a satisfactory supply. Further east near the California Cotton Mills and extending quite indefinitely towards Fitchburg, water is known to be abundant at various depths. At the Cotton Mills, three thirteen-inch wells, 75 feet, 220 feet and 300 feet in depth respectively produce 5,000 and 10,000 gallons per hour. Several feet of coarse gravel is found less than 50 feet from the surface in this general locality. Throughout Fruitvale and Alameda and extending out to Fitchburg no trouble is experienced in obtaining water in abundance. No deep well borings (comparatively speaking)have ever been made in Oakland, so far as I have learned.

At the foot of Myrtle street upon the property now occupied by the Howard Company, many years ago two ten-inch wells were drilled to a depth of 554 and 681 feet respectively, and an abundance of good water obtained at this depth.

In a few instances flowing (artesian) wells have been developed. Near Seventh and Kirkham streets, such a well flowed for several years, also one flowed at the foot of "B" street, West Oakland Marsh. Near the Cal. Cotton Mills, water now rises practically to the ground surface and at Golden Gate three wells are flowing above the surface at the present time. A flowing well was also very recently developed near Eighth and Fallon streets. The general direction of the under ground flow (west of Lake Merritt) appears to be from the northeast toward the southwest. Wherever this water may have its source the quality is uniformly pure and good and the quantity has never as yet been affected by drought or artificial draft, in a general sense. The water is clear and cool and somewhat hard, the effect of contact with lime formations. The indications certainly are that the flow is perennial in a very large measure. In some localities in the City water is especially abundant. This is true in the vicinity of Valley street, also at Twenty-sixth and Myrtle streets; also near Union and Fifth streets; near the Golden Gate R. R. Station; throughout West Oakland, and in lower eastern part of East Oakland. At Alden water is also very plentiful at shallow depths.

As a rule, water from shallow wells, particularly in large cities, is considered absolutely unsafe for domestic use. With this fact in mind, especial inquiry was made as to the health of the people using water from the numerous shallow wells which draw only from the first stratum and in not one case were any ill effects reported. In many cases, it was stated, analysis had been made of the water as

a precaution, and the quality, in all such instances, proved to be very satisfactory.

As a rule bored wells are drilled to the second, third, or fourth gravel stratum and the flow from the first gravel cased off, together with all surface drainage.

So far as I can learn, however, the quality of the water from the first gravel is quite as free from organic impurities as from the lower streams, but the general opinion is that it is somewhat harder.

In several instances it was reported that the degree of hardness of the water varied considerably from time to time.

Without an exceptional case, the consumers express themselves as perfectly satisfied with their water supply and it was quite entertaining to be informed, with remarkable frequency, that "I have the very best well of water in this City."

"It is not by any means uncommon for shallow wells to intercept veins of water gathered on distant and higher water sheds and the water may have been subjected to natural purification before it reaches the well. In such cases, if all surface drainage is excluded, the water may be of high quality and altogether safe." Certainly all reports sustain the shallow wells as producing good, pure water and any natural prejudice against such wells, may in this instance be discarded.

The largest private water plant in this City at present is owned by Mr. Sicoth at Eighth and Willow streets. He has a 12-inch well, 60 feet deep, 22,000 gallon tankage and now supplies 25 houses.

Among the larger private plants the laundries take the lead. They all have their own wells and each uses from 15,000 to 40,000 gallons of water per day.

Some speculation is no doubt appropriate, relative to the volume of the under ground waters of this locality and of the reasonable possibilities of developing same. Of course, the superficial nature of this investigation renders any attempt at positive assertion inconsistent, but at the same time, by considering the facts as presented and by making comparisons with other cities which depend upon ground water supplies some crude general conclusions may be ventured. It should be observed, however, that it is perfectly feasible to determine with a fair degree of accuracy, the direction, velocity and volume of flow of the underground streams which feed the pervious sands and gravels underlying this locality. This would require a long series of observations and pumping tests including the boring of numerous test wells, all of which would consume at least one year's time and the expense would amount to several thousand dollars.

The modern methods of prospecting for water give results which leave nothing further to be desired so far as proving the quantity available, for which reasons immature conclusions may well be suggested with much hesitancy.

Referring to local experience with ground water supplies—we have first—the operations of Mr. Dingee within the City prior to concentrating his plant at Alvarado.

At 26th and Myrtle streets, Mr. Dingee drilled three wells upon a lot about 50 feet in width. The hydraulic gradient of these

wells was but a few feet below the ground surface, and to facilitate pumping, a tunnel was excavated, connecting the wells, at an elevation of about 15 or 20 feet below the surface. This tunnel served as a reservoir or pump. At the same time I am informed, water was also obtained from the well about one block distant, upon the premises of Mr. Gill, the nurseryman. This latter well is said to be 281 feet deep and to have yielded upwards of one million gallons per day, being equal in production to the other three wells. No exact data is available relative to the quantity of water produced from this plant. One informant has stated that 600 houses were supplied but considering that one million gallons per day will supply, at present rate of consumption in Oakland, (150 gallons per capita) about 7,000 people, the number of houses supplied must have been more nearly 1,400, allowing five persons to each family.

Mr. Dingee also had a pumping plant drawing water from four wells near 5th and Union streets. These wells penetrated the fine waterbearing sand to a depth of 53 feet and are said to have yielded about 5,000 gallons per hour each, equal to 480,000 gallons per day. Water was also pumped by Mr. Dingee from a well in the vegetable garden at Fifteenth and Willow streets, but no information as to the volume has been obtained. In all these cases the water was pumped directly into the street mains. At either of these three points, the supply was not appreciably diminished, so far as has been ascertained. At Twenty-sixth and Myrtle streets the water plane was lowered for several hundred feet distant to the northeast from the pump, but I heard of no wells being exhausted. It is probably safe to assume that 1½ million gallons per day was produced from these three sources. The second groundwater supply in the order nearest the City—is the Fitchburg plant, which until a few months ago, furnished Alameda almost exclusively.

This plant comprises 72 10-inch wells, ranging from 150 to 270 feet in depth. They are spaced in two parallel rows, distant about 50 by 150 feet apart, and cover all told less than 10 acres of ground, allowing a margin outside of each row. These wells supplied about 14,000 people at the rate of about 75 gallons per capita, equal to 1,050,000 gallons per day, for several years without showing any reported tendency to fail.

At Roberts' Landing, several wells have been bored to a depth approximating 500 feet. Two or three of these wells are "artesian." The City of Oakland made a test of one of these wells, by the air lift process, under writer's supervision, during the preparation of the late water trial. The average daily flow was 578,000 gallons.

The Alvarado Works, originally owned by the O. W. Co., included 368 acres of land, upon which were bored 32 wells ranging in depth from 170 to 884 feet, the general average depth being 350 feet.

On thanksgiving Day, November, 1894, the date of first delivery of Alvarado water into Oakland, about 15 wells were in service. The additional wells were bored during the succeeding years 95-96-97-1898 to meet the increasing patronage of that Company.

The average daily supply from these wells has been about 4½ million gallons. On July 15, 1897, 7,159,440 gallons were pumped. These Alvarado wells are placed irregularly, some are in groups, others a considerable distance apart. Adjacent to the 368 acre tract the original C. C. W. Co. purchased 12 acres of land and bored 16 wells thereon, installed a pumping plant and an alleged effort to exhaust the Dingee wells was made, without success. It has been variously estimated that from two to three million gallons per day was pumped into the Bay.

The Alvarado Sugar Works has five wells ranging from 350 to 550 feet in depth from which during the working season, about 4 million gallons per day are pumped. The foregoing constitutes the principal ground water supplies in this vicinity. These properties for the purposes of this discussion, simply call attention to the fact that a large quantity of water is obtained locally from comparatively small areas of land, the geological and topographical features of which are quite similar to those of Oakland. The following tabulated statement will show the general character of the ground-water supplies in some 13 cities of prominence.

The computed areas of land actually covered by the groups of wells, allowing twice the width between rows for margins seems remarkably small. Brooklyn has 765 wells divided into nine groups, ranging from 27 to 154 feet deep covering in the aggregate less than 10 acres of ground. Lowell, Mass., has 340 wells divided into four groups upon less than seven acres of ground, in the aggregate.

Fort Worth obtains its supply from 95 wells only 24 feet in depth.

Columbus, Ohio, from 34 wells ranging from 75 to 80 feet deep.

Memphis has 41 wells ranging from 260 to 480 feet in depth and Galveston 30 wells from 750 to 850 feet.

At Leipsic, Germany, the water supply is taken from 324 shallow wells.

It may be stated that ground water supplies as a general thing are reasonably satisfactory and are not infrequently, among our towns and cities, the only available source.

In some cases the wells are bored to great depth, from 1,000 to 3,000 feet.

## DRIVEN WELL PLANTS IN VARIOUS CITIES.

| CITY. | Wells Diameter Inches | Wells Depth Feet | Number of Wells in Plant | Number of rows of wells. | Distance apart of rows—feet. | Distance apart in each row—feet. | Nature of water-bearing stratum. | Remarks. |
|---|---|---|---|---|---|---|---|---|
| Brooklyn | 2 | 30 to 42 | 100 | 2 | 14 | 14 | Sand | Regular in straight lines |
| " | 2 | 27 to 73 | 183 | 3 | 17 and 36.5 | 14 | Sand | Regular in straight lines |
| " | 2 | 33 to 56 | 110 | 2 | 18 | 16 | Sand | Regular in straight lines |
| " | 2 | 33 to 56 | 130 | 2 | 18 | 18 | Sand | Regular in straight lines |
| " | 2 | 29 to 53 | 150 | 2 | 28 | 16 | Sand | Regular in straight lines |
| " | 4.5 | 45 | 82 | 2 | 24 | 75 | Sand | Staggered |
| " | 6 | 42 to 75 | 13 | 2 | 70 | 50 | Sand | Staggered |
| " | 6 | 48 to 53 | 12 | 2 | 24 | 76 | Sand | Staggered |
| " | 8 | 148 to 154 | 4 | 1 | ..... | 50 to 600 | Sand | Irregular |
| Ft. Worth | 2 | 24 | 95 | 2 | 6 | 18 | Gravel | Staggered |
| Lowell | 2 | 45 | 70 | 2 | 12 | 25 | Gravel | Regular |
| " | 2 | 45 | 50 | 2 | 12 | 12 | Gravel | Regular |
| " | 2.5 | 27 to 40 | 169 | 2 | 12 | 24 | Gravel | Staggered |
| " | 6 | 47 to 67 | 51 | 2 and 3 | 50 to 100 | 50 | Gravel | Irregular |
| Schuyler | 2.5 | 50 to 67 | 26 | 2 | 4 | 33 | Gravel | Regular |
| Columbus | 6 | 75 to 80 | 34 | 1 | ..... | 32 | Gravel | Regular |
| Plainfield | 6 | 35 to 40 | 20 | 2 | 20 | 50 | Gravel | Staggered |
| Memphis | 6 | 260 to 480 | 10 | 1 and 2 | 50 to 200 | 50 to 200 | Sand | Irregular |
| " | 8 | 26 to 480 | 31 | 1 and 2 | 50 to 200 | 50 to 200 | Sand | Irregular |
| West Superior | 8 | 45 | 4 | 1 | ..... | Av. 19 | Gravel | Straight lines |
| " | 6 | 45 | 77 | 1 | ..... | Av. 16 | Gravel | Straight lines |
| Galveston | 7 | 750 to 850 | 27 | 1 | ..... | 300 to 500 | Sand | Straight lines |
| " | 9 | 750 to 850 | 3 | 1 | ..... | 500 to 750 | Sand | Straight lines |
| Liepsic | 7 | 50 to 70 | 324 | 1 | ..... | 33-38 and 6 | Gravel | Straight lines |
| Camden | 8 | 100 | 70 | 1 | ..... | 200 | Gravel | Regular |
| Savannah | 12 | Av. 500 | 12 | 1 | ..... | 300 | Porous limestone | Straight lines |
| Fitchburg | 10 | 150 to 270 | 72 | 2 | 100 | 50 | Gravel | Straight lines |

It certainly is interesting to contemplate what the result would be if several groups of wells were bored at widely separated points within the City at points where water is known to be comparatively abundant. The present actual requirements of this city under a metered system upon a basis of 75 gallons per capita would be about six million gallons per day.

It appears to be a fact that an ordinary well in the best localities easily produces 5,000 gallons per hour, equal to 120,000 gallons per day. Upon this basis fifty wells would supply the City at the present time. At the East Oakland Cotton Mills, one well is now producing 10,000 gallons per hour. Mr. Gill claims his well produced one million gallons per day, equal to 41,000 gallons per hour It is very much to be regretted that no data from actual pumping tests of the most productive wells is available. The operations of Mr. Dingee appear to include all experimental work of this character. In one instance, it is reported that his pumping plant exhausted the water supply, at a point in Alden about half way between Telegraph avenue and Broadway on Forty-ninth street. At the other points where pumping plants were established, no shortage of water was experienced, so far as I have learned.

The area of Oakland is about 18.8 square miles, equal to 12,032 acres. Cutting off all that portion east of Cemetery Creek and north of East Twenty-second street as non water producing, leaves about 20,000 acres of proven water bearing territory. If we assume that the aggregate average depth of the saturated sands and gravels throughout this area is only ten feet and the void one-sixth of the volume we have in storage 5,445 millon gallons of water, which would require 2½ years to exhaust at the rate of six million per day, without allowing for any inflow whatever The field is not restricted to the limits of Oakland, however. As previously stated the Fruitvale and Fitchburg localities yield abundant water and along the Bay shore north of Berkeley is said to be also a promising field for ground supply. In view of the foregoing statements, it appears reasonable to assume that sufficient water to meet the present actual needs of 100,000 population, could be developed locally. It may be remarked that the first cost of a local ground water supply would be the minimum. The cost of operating separate pumping plants, now that cheap fuel or electric power is available is much less than formerly and is not seriously objectionable. In connection with such a project no investment need be made, beyond the cost of drilling and testing wells, in advance of proving the sufficiency of the supply.

The following tabulation will show the elevation of the water plane relative to high tide line, and the ground surface at various points in the City. The selections were taken at random from the notebooks. As a rule the data was given off hand by the occupants of premises and it can not be considered accurate. The elevations relative to high tide were computed from the official street grade elevations. The water table is affected slightly by the tides, and is, of course, affected locally at individual wells according to the draft, to certain limits, dependent upon the rate of inflow.

| Location of Well. | Depth of Well. | Normal Elevation of Water Below Surface of Ground. | Normal Elevation of Water Relative to High Tide. |
|---|---|---|---|
| 22nd and Broadway | 73.0 | 9.0 | 0.0 |
| Web. & Hawthorne | 160.0 | 61.0 | 14.0 above |
| 36 & Market | 50.0 | 10.0 | 25.0 " |
| 25 & Telegraph Ave | 60 0 | 9 0 | 13.0 " |
| 34 & Elm | 39.0 | 20.0 | 32.0 " |
| 36 & Grove | 115.0 | 15.0 | 38.0 " |
| 36 & Chestnut | 27.0 | 10.0 | 19.0 " |
| 20 & Brush | 404.0 | 20.0 | 0.0 " |
| 29 & West | 130.0 | 40.0 | 10.0 below |
| 3 & Harrison | 121.0 | 20.0 | 9.0 ,, |
| 6 & Alice | 60.0 | 8.0 | 11.0 above |
| 8 & Jackson | 190.0 | 30.0 | 2.5 below |
| 1 & Linden | 250.0 | 22.0 | 18.0 below |
| 7 & Filbert | 60.0 | 10.0 | 6.5 above |
| 7 & Kirkham | 60.0 | 10.0 | 0.0 |
| 13 & Kirkham | 60.0 | 10.0 | 4.6 above |
| 14 & Peralta | 114.0 | 7.0 | 2.5 " |
| 14 & Brush | 28.0 | 14.0 | 14.0 " |
| 5 & Peralta | 48.0 | 8.0 | 2.5 below |
| 20 & Myrtle | 69.0 | 9.0 | 0.0 |
| 13 & Willow | 160.0 | 8.0 | 0.0 |
| 21 & San Pablo Ave. | 115.0 | 30.0 | 13.0 below |
| 30 & Myrtle | 30.0 | 14.0 | 9.0 above |
| Isabella, Mkt—S.P.Ave | 125.0 | 14.0 | 0.0 |
| 26 & Filbert | 33.0 | 11.0 | 3.0 below |
| A & Ettie | 185.0 | 4.0 | 2.0 " |
| 8 Ave. & E. 22nd | 70.0 | 24.0 | 48.0 above |
| Cotton Mills | 10.0 | 7.0 | 3.0 " |
| 45 & Cherry | 195.0 | 14.0 | |
| Niles & Maple | 41.0 | 18.0 | |
| 57th & S. P. Ave | 150.0 | flowing | |
| 61 & Idaho | 30.0 | 15.0 | |

In conclusion it is proper to say that the number of private wells in this city is rapidly increasing. Several corps of well drillers are constantly at work. Probably one hundred wells per year is not an over estimate of the rate of increase at the present time. The estimated number of families supplied from private wells is based upon a general average of two families per well. This data was given reluctantly and in the majority of cases was not obtained. The actual figures show a higher average, but I am convinced the rate allowed is conservative. The population supplied was computed upon the basis of five persons to each family.

It should not be inferred from the foregoing that it is considered desirable to undertake to develop sufficient water, from local sources to meet the increasing demands of this rapidly growing city. The possibilities of development certainly are restricted.

It does seem probable, however, that sufficient water to serve all requirements at present and a few years to come, under conservative regulations, can easily be obtained right at home if no other supply is more available.

Respectfully submitted,

M. K. MILLER,

Civil Engineer

(Received Nov. 15, 1902.)

# SPECIFICATIONS

FOR THE

# Construction of an Iron Pipe Line

FOR THE

## Spring Valley Water Works

JULY 12th, 1887

DE WITT & SNELLING
BOOKSELLERS
111 TELEGRAPH AVE. OAKLAND, CAL.

# SPECIFICATIONS

FOR THE

# Construction of an Iron Pipe Line

FOR THE

## SPRING VALLEY WATER WORKS.

# SPECIFICATIONS.

## A.

### General Description.

The proposed conduit to connect the Spring Valley Water Works stone aqueduct at a point about 1¾ miles above Vallejo's Mill, on the Alameda Creek, Alameda County, with the 44 in. Crystal Springs pipe at or near the point where the same enters the county road about 1¾ miles northerly from San Mateo.

The total length of this conduit is 146,000 feet, and consists of 139,400 feet of 36 in. wrought iron pipe and 6600 feet of submarine ball-joint pipe.

The conduit is distributed as follows: Starting from the above mentioned stone aqueduct on Alameda Creek, and generally following the line of the present old Vallejo's Mills flume; thence past Vallejo's Mill across Alameda Creek on a bridge (above high water); thence following in a southeasterly direction along the public road, through the towns of Centerville and Newark; thence along the railroad right of way, through the salt marsh on a pile trestle to Dumbarton Point (crossing a navigable slough, 300 feet wide, with submarine pipe on the way); thence across the Bay of San Francisco in a southwesterly direction and in a straight line 6300 feet, more or less, of submarine pipe to the westerly shore of the bay.

At this point the 36 in. pipe commences again, and runs first along a pile trestle, about 2000 feet long, through the marsh and in a southwesterly direction to the public road; thence along said public and county roads through Menlo Park, Redwood City, Belmont and San Mateo to the above junction with the 44 in. Crystal Springs pipe.

The sizes of pipe, thickness and character of the metal over the above route are described as follows: Beginning at the eastern or inlet end of the aqueduct and going toward its northwesterly end or outlet:

1—35,700 feet 36 in. pipe, No. 9, iron in ditch.

Of No. 2 and 4 about 17,000 feet on trestles through marsh, and 9,700 feet in ditch.

2—19,000 " 36 in. " " 7, to the slough.
3— 300 " submarine pipe, dimensions stated hereafter.
4— 7,700 " 36 in. pipe No. 7, to Dumbarton Point.

5— 6,300 " submarine pipe across the Bay of San Francisco, dimensions stated hereafter.

6— 2,000 " 36 in. pipe No. 7, through marsh on trestles.

7—75,000 " 36 in. " " 9, laid in ditch.

## B.

### Specifications for the Manufacture of 139,400 feet of Wrought Iron Pipe of a clear diameter of 36 in.

The following are the specifications for the manufacture of the iron and rivets to be used in the construction of this 36 in. pipe, the materials described therein to be furnished by and at the expense of the Spring Valley Water Works, and to be delivered on the sidewalk in front of the place of manufacture.

### Specifications for the Manufacture of Iron Plates.

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | |
|---|---|---|---|---|---|---|---|---|---|
| No. | No. Sheets. | Size of Sheets, Ins. | Thickness, Ins. | Weight per Sqr. Ft. lbs. | No. of Sqr. Ft. per Sheet. | Weight per Sheet. lbs. | Total Weight lbs. | Total Weight Tons. | Total Weight Tons. |
| 9 | 15,750 | 116x44 | 0.163 | 6.5 | 35.44 | 230.36 | 3,628,170 | | |
| 9 | 15,750 | 117x44 | 0.163 | 6.5 | 35.75 | 232.375 | 3,659,205 | | |
| | | | | | | | 7,288,075 | $3,644\frac{75}{100}$ | |
| 7 | 4,100 | 117x41 | 0.187 | 7.5 | 35.75 | 268.13 | 1,099,333 | | |
| 7 | 4,100 | 118x44 | 0.187 | 7.5 | 36.05 | 270.37 | 1,108,517 | | |
| | | | | | | | 2,207,850 | $1,103\frac{925}{1000}$ | $4,747\frac{925}{1000}$ |

Each plate to be sheared perfectly true to the above dimensions given in the third column, the sides and ends being straight and rectangular with each other.

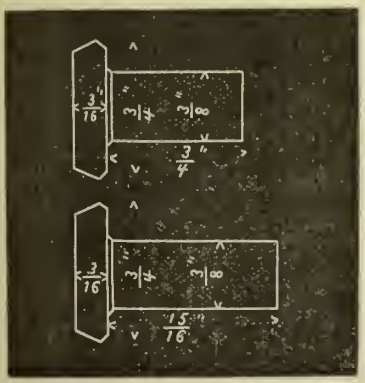
The weight of each plate not to fall below $6\frac{4}{10}$ nor above $6\frac{6}{10}$ lbs. for No. 9, and not below $7\frac{4}{10}$ nor above $7\frac{6}{10}$ lbs. for No. 7, per square foot. The weight given in column 5, representing the average weight required. Each plate being perfectly flat, smooth and even and free from warping, buckling, splits, flaws, rust, and all other defects. The tensile strength of the iron to be not less than 50,000 lbs. per square inch, and the elastic limit to be not less than 40 per cent. of the above.

The iron must be of American manufacture, close-grained, tough and thoroughly pliable, allowing cold scarfing to a fine edge at the laps without splitting or cracking, and not to crack between the rivet holes, nor between the holes and the edge of the plate while being rolled.

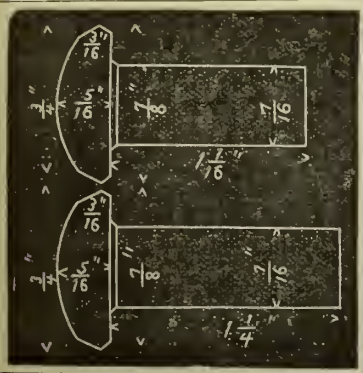
All plates exhibiting a hard and brittle character, and that do not in every way meet the above requirements, will be rejected.

Specifications for the Manufacture of Rivets.—The Dimensions Given in the Following List to be Strictly Adhered to:

RIVETS FOR NO. 9 IRON.

| DIAGRAM. | Position of Rivets. | Size of Body. | Size of Head. | App. No. per lb. | Total No. Required. | App. No. per 100 lb. Keg. | No. of Kegs @ 100 lbs. | Total Weight lbs. | Total Weight lbs. |
|---|---|---|---|---|---|---|---|---|---|
|  | Seam rivets | $\frac{3}{8}$x$\frac{7}{8}$ | $\frac{3}{4}$x$\frac{3}{16}$ | 25 | 5,040,000 | 2,500 | 2,016 | | |
| | Lap rivets | $\frac{3}{8}$x1$\frac{5}{16}$ | $\frac{3}{4}$x$\frac{3}{16}$ | 21 | 220,500 | 2,100 | 105 | | |
| | | | | | | | 2,121 | 212,100 | |

RIVETS FOR NO. 7 IRON.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
|  | Seam rivets | $\frac{7}{16}$x1$\frac{1}{16}$ | $\frac{5}{16}$x$\frac{7}{8}$ | 12 | 1,066,000 | 1,200 | 888 | | |
| | Lap rivets | $\frac{7}{16}$x1$\frac{1}{4}$ | $\frac{5}{16}$x$\frac{7}{8}$ | 11 | 57,400 | 1,100 | 53 | | |
| | | | | | | | 941 | 94,100 | 306,200 |

The rivets to be of or equal to the brand known as "Burden Rivets."

To be made of the best kind of American iron; the iron being soft, pliable and thoroughly malleable; the rivets being free from splits and cracks, rust or any other defects.

The iron of which the rivets are manufactured to have a tensile strength of not less than 50,000 lbs. per square inch, its elastic limit to be not less than 40 per cent. of the above.

All rivets not up to the above requirements will be rejected.

The plates to be delivered at the rate of 1000 tons per month, commencing August 1st, 1887. The rivets at the rate of 600 kegs per month.

## Manufacture of Pipe.

During the process of manufacture of the pipe, all the plates and rivets delivered to the contractor must be kept under roof and cover by him, and in no way exposed to rain or fogs.

The pipe to consist of large and small straight courses. The sheets for the large and small courses, both for Nos. 9 and 7, are to be trimmed to the exact size given, with the opposite sides parallel to each other, and the corners rectangular.

The sheets for the small courses to be so trimmed that, when punched and riveted into courses, they form a tight fit into the large course.

The rivet holes are to be punched according to the dimensions given in the following table:

| No. of Iron, inches. | Distance center to center in each row of straight seams, inches. | Distance center to centre between 2 rows of straight seams, inches. | Distance center to center round seams, inches. | Distance center of seam to edge of sheet, inches. | Diameter of Rivet, inches. | Diameter of Rivet Hole, inches. |
|---|---|---|---|---|---|---|
| 9 | 1.50″ | 0.75″ | 1.0″ | 0.75″ | $\frac{3}{8}$″ | $\frac{13}{32}$″ |
| 7 | 1.80″ | 1.00″ | 1.50″ | $\frac{3}{8}$″ | $\frac{7}{16}$″ | $\frac{15}{32}$″ |

Where at the end of each course the lap falls between two thicknesses of iron, the sheets must be drawn to a fine edge, through which edge upon riveting the courses together, one of the rivets, of the round seam, must be driven to insure absolute tightness.

Each plate must be rolled to a perfect cylinder of the required diameter.

All riveting in the shop must be done with cold rivets and by hydraulic machinery, exerting a slow pressure of not less than 20,000 lbs. on each rivet head. Prior to driving the rivet the plates must be pressed together by a squeeze from the same machine. The head of the rivet on the inside and outside of the pipe to be formed by a cup in the die, and the inside rivet head to receive as nearly as possible the shape of the original head, while for the outside the head is to retain its original dimensions as near as possible.

At each jnnction of the straight seam and round seam, where three thicknesses of iron come together, the lap rivets as provided in the above list are to be used.

The straight seams to be all on one side of each length of pipe, alternating to the right and left not more than one foot.

The pipe to be manufactured in lengths of eight courses each, in large and small straight courses, so that each length has a large course on one end and a small course on the other end.

If the Spring Valley Water Works should wish to somewhat alter the number of courses to each length the contractor must comply with it; such alteration not to exceed two courses either way.

Both ends of each length having the regular round seam rivet holes.

All round and straight seams to be thoroughly split and caulked in first-class boiler work fashion, while for a distance of four inches from all laps the seams are to be chipped and caulked.

The Spring Valley Water Works' agent to have the right to test any of the lengths.

The pipe must be absolutely tight, without asphaltum coating, under a pressure of 125 lbs. per square inch.

All the work of punching, riveting, caulking, etc., to be done with the very best of workmanship, so as to insure strength and absolute tightness.

The Spring Valley Water Works to dip the pipe in asphaltum coating at their own expense at or in the immediate proximity of the shop where the pipe is manufactured.

The contractor to furnish to the Spring Valley Water Works, free of cost to them, sufficient room for them to erect their boiling kettles and dipping troughs, derrick, etc., and also a sufficient space for the storing of the pipe so dipped prior to its transportation.

## C.

### Transporting the Pipe.

The contractor is to transport the pipe from its place of storage where it was deposited after having been dipped, to and along the line above outlined.

The pipe to be carefully loaded on teams, cars or vessels not more than two tiers high (unless by special consent of the Spring Valley Water Works) with skids and blocking and straw sacks in between, so that the coating is not chafed or rubbed off. Great care being taken in unloading the pipe at the point of destination; here the pipe to be carefully unloaded, lowering the same to the ground slowly over skids with ropes and on sacks filled with straw. Special care being taken that the pipe does not come in contact with salt water during its transportation, and after it has been deposited on the ground; wherever the pipe has to be deposited on the salt marsh, this must either be done on the old railroad embankment or on wooden blocking, so as to keep it above high water. When the pipe has been deposited alongside of the ditch or trestle-work, the top of the same to be covered by either plank or straw and loose earth thrown over it, to keep the sun from melting off the asphaltum.

## D.

### Excavating the Ditch.

The ditch to be excavated for the entire length along the line indicated above, except at the bridge crossing near Vallejo's Mill, and except the crossing of the salt marshes, the slough and the Bay of San Francisco, and the crossings of various creeks and other minor depressions which will be crossed by bridges.

The ditch shall be excavated to a width of 5 ft. 6 in. on top, 4 ft. 6 in. on the bottom, and to a depth of 5 ft. 6 in.

These being the dimensions of the ditch from the neighborhood of Vallejo's Mill to Centerville, and from the westerly end of the trestle near Ravenswood to the point of junction with the 44 in. pipe near San Mateo.

The ground at the upper end of the conduit between the stone aqueduct and Vallejo's Mill being slightly uneven, the above dimensions cannot be strictly adhered to, except regarding the width of the bottom.

In this case the ditch is to be dug to a greater or less depth as directed by the Spring Valley Water Works' engineer, and for any extra cutting over the above regulation size the contractor to be paid per cubic yard; as also where the cutting is less than the above size, an allowance to be made to the Company (Spring Valley Water Works).

Where the line of the pipe crosses adobe soil or such soil as in the opinion of the Spring Valley Water Works' engineer contains a proportion of adobe, as appears from Centerville to the salt marsh, and particularly from a point about a mile east of Newark to the salt marsh, the ditch is to be dug of the following dimensions: Width on top, 5 ft.; depth, 5 ft. 8 in.; width at a point 3 ft. 6 in. from the surface or 2 ft. 2 in. above the bottom, 4 ft. 6 in.

The ditch below this point to be excavated to the bottom to an even curve of a radius of about 2 ft. 3 in.

The ditch to be kept free from land slides, or other debris; to be dug straight, except on the few curved portions, where the curve must be uniform; the sides, and particularly the bottom, to be dug straight, uniform and even to a perfect grade (grade to be given by the Spring Valley Water Works' engineer), so that the pipe has an even bearing on the bottom over its entire length.

Wherever the ditch is dug through private property, the top or surface soil to be placed on the bank of the ditch by itself and not mixed with the rest.

All excavated materials to be kept not less than two feet from the edge of the bank of the ditch.

## E.

### Construction of Trestle Works.

The piles to be used for the foundation must be driven two abreast and four feet from center to center and fourteen feet one inch apart longitudinally from center to center. They must be driven perpendicularly, and until in the opinion of the Spring Valley Water Works' engineer they reach firm and solid foundation; their maximum depth not to exceed 30 ft. below the bottom of the cap. The exact levels at which the piles are to be cut off to be given by the Spring Valley Water Works' engineer, but shall not be more than 1½ ft. below the surface of the marsh, and will average about 1 ft. below the same. A frame to be constructed on the top of each set of two piles in the

manner shown in the accompanying plan. The sill of each frame to be bolted to each pile by a drift bolt 24 in. in length and 1 in. in diameter (the bolts being the same as used by the State Harbor Commissioners for wharf building in San Francisco), driven through the cap and into the center of each pile—the holes for such drift bolts to be bored of a somewhat smaller diameter than the bolts, so that the bolts will fit firmly in them.

The longitudinal stringers to be bolted to the upper caps by 1 in. bolts with threads, nuts and washers—while the upper cap and lower sill are to be fastened to the two uprights of each trestle by four 6 in. spikes and by two iron dogs 12 in. long of ⅞ in. iron driven 4 in. and set diagonally and in opposite direction at each junction of the uprights with cap and bottom sill.

The frame for covering the pipe shall be constructed as shown in plan.

Piles to have a diameter at upper end, clear of bark, of not less than 12 in., and at the lower end not less than 8 in.

All piles, showing rot, splits or other defects, will be rejected.

Neither the longitudinal stringers nor the frame over the pipe shall be placed and fastened in position until after the pipe is laid upon the bents.

12 d. nails 4 in. apart to be used for nailing the outer planks on the 4 in. x 4 in. frame, 60 d. nails to be used in spiking frame to stringers and top cap and cross braces on frame.

The workmanship and materials and quality of construction to be in all particulars the same as shown in the construction of the pipe trestle crossing the San Bruno marsh.

The sill, uprights and diagonal braces and outside boarding to be of first-class, sound, well seasoned redwood, while the top cap, stringers, floor planking and frame scantlings are to be of first class, sound, well-seasoned pine.

The longitudinal stringers to be bolted on and the frame and the top covering to be put on immediately after the pipe is put in position and riveted, in order to prevent the expansion and contraction of the pipe from breaking down the trestles.

The box and trestle works to be painted with a heavy coat of brown fire-proof paint, as used by the railroad companies.

The Spring Valley Water Works will construct at their own expense the bridges necessary for crossing Alameda Creek at Niles Station, and also the bridge crossings on the west side of the Bay and at San Mateo Creek.

## F.

### Laying of the Pipe.

The necessary joint holes to be dug by and at the expense of the contractor, and of such width and depth as are necessary for the proper driving of the rivets and splitting and chipping and caulking and painting of the joints.

The lengths of pipe to be so placed in the ditch that the rivet holes in the small course at one end of each length are accurately opposite to the corresponding rivet holes in the large end course of the next pipe.

In the few bends in the pipe line the pipes are to be put together by butt and strap joints, which straps are to be of the same number and quality of iron as the pipe, but not to be more than six inches in width in their widest part. In placing the pipe in the ditch the straight seams to be placed at the bottom. Before the lengths are fitted and riveted together, the ends of each length are to be carefully scraped and entirely cleaned of the asphaltum coating for a distance of 3 inches from each end, both in and outside of the pipe, so that the joint makes a perfect union of iron to iron. The rivet holes to be reamed out so as to be perfectly free from asphaltum. The seams of these joints to be riveted with hot rivets, the rivets forming a good substantial head, both in and outside of the pipe, of a shape and proportion similar to that in the other seams, care being taken that a rivet is placed through the scarfed edges of the sheet at all the laps, for which laps the lap-rivets are to be used as specified for the pipe. Where the curvature of the pipes is so great that the above strap joints are insufficient to make the pipe follow such curves, the same is to be accomplished by inserting one or more single courses, or such single courses intermingled with lengths of pipe. The strap joint necessary for this purpose to be constructed the same as specified above. The contractor to furnish manholes, blow-offs, blow off gates and air valves of such dimensions as specified in the accompanying drawings. He to connect them with the pipe in such places as the Spring Valley Water Works' agent directs. Each one of the above being provided with a wrought-iron ring $\frac{5}{16}$ in. x 3 in. on the inside, the hot rivets passing through it and the iron of the pipe and the flange of the respective attachment. Only hot rivets being used for this purpose, and the edge of the plate to be chipped

and caulked against the inside face of the casting, the rivet-joints as well as the apparatus so attached to be perfectly water-tight.

The contractor to bid separately for the man-holes, air-valves, blow-offs and blow-off gates by the piece, put on the pipe and in complete working order. He also to put over each one of the above fittings a square box made of 2-in. redwood plank, with 4 in. x 4 in scantling in the corners, with cover of same material.

For the man-holes the boxes being 4 ft. x 4 ft. outside measurement, and for the blow-off gate and air-valve to be 3 ft. x 3 ft. outside measurement.

The lower edge of the fore and aft side of the box to be cut out with the curve of the pipe so as to rest on the same.

In those portions of the ditch which pass through the adobe region as before mentioned, the ditch to be evenly filled to a depth of 4 in. above the curved bottom with sandy, clayey or fine gravelly material prior to placing the pipe in the ditch.

The rest of the ditch in this adobe region, up to within one foot of the top of the pipe and then curving over the top of the same to the thickness of not less than 4 in. on the top, to be of the same material as above specified for the bottom of the pipe.

The balance of the ditch and heaping to a rounding of say 1 ft. above the ground (except in road crossings, where the crowning should not exceed 6 in.) to be filled with the material that was excavated out of the ditch.

In such portions where the line crosses private property, the lower materials to be put in first, and the excavated loam to be put in last.

For the entire length of the ditch, whether in adobe or other soil, the material is to be packed tightly with short sticks first, and afterwards with ordinary rammers under, alongside, and on top of the pipe; no water being used for packing said dirt, except with special consent of the Spring Valley Water Works' engineer.

The moment a length of pipe is placed into the ditch, and after the two round-end seams have been fastened together with tap bolts, the filling of the ditch in the above careful manner to commence and to be carried on until the top of the pipe is covered 4 in. deep and thereby removed from the influences of the sun.

After the round seam has been properly riveted, chipped and caulked at laps, and split and caulked in the best boiler work fashion for the balance of the round seam, and after the Spring Valley Water Works' agent has passed upon the work, then the Spring Valley Water

Works, at their own expense, to paint this riveted joint in and outside of the pipe.

Thereafter the filling and ramming of the balance of the ditch proceeds until the filling is completed as above described.

## G.

### Submarine Pipes.

The submarine or ball-joint pipe consists of two separate sections. One section having a length of 300 ft., crossing a navigable slough about 1½ miles northeasterly from Dumbarton Point; the other and main section crossing the narrow neck of the Bay of San Francisco in a southwesterly direction from Dumbarton Point, having a length of about 6300 ft. On fully one-half of this crossing the water is very shallow, while on the remainder—in the so-called channel—the water gradually deepens from 2 fathoms below tide down to 8 fathoms; the deepest channel, of about 8 fathoms, being about 1000 ft. from the Dumbarton shore. (See profile of bay).

The contractor is required to bid on the following:

**1st.** To furnish and lay these two sections of submarine pipes, viz: 300 ft. and 6300 ft., or a total of 6600 ft., by a double line of cast iron, Ward patent ball-joint pipe, 16 in. in the clear diameter, requiring a total length of 13,200 ft. This pipe to weigh 180 lbs. to the running foot, the metal in the body of the pipe being 1 in. thick, while the bell and nipple ends are proportioned as shown in the accompanying drawing.

Each joint, when finished, to have a flexibility of 20 degrees. The cast iron must be the best quality of soft grey, close-grained iron. The pipe to be cast on end of even thickness and smoothness throughout, and true to the dimensions given in the drawing.

The bell being turned out to an absolutely perfect smooth, concave sphere, and the end of the nipple being turned and beveled to fit tightly against the inner bevel of the bell.

The pipes to be thoroughly coated in asphaltum, in and outside, except the inside of the bell, to be entirely free from spilts, flaws, blow-holes or any other defect.

Great care being exercised in handling these pipes, always lowering them slowly with ropes on straw sacks and sticks of wood between it and the next pipe, to prevent iron from striking iron.

The contractor to test every length of pipe, in presence of the agent of the Spring Valley Water Works, after the pipe has been delivered on the pipe laying barge, to a pressure of 200 lbs. to the square inch; and any pipe that shows splits, flaws, leaks or other defects, will be rejected.

One end of the pipe-laying barge to have an apron attached, mounted with two steel rails set the proper distance apart, so that the bells of the pipe slide down on the same. The apron also to have a heavy timber guard, not less than 16 in. high, and the upper inner edge mounted with angle iron, so that in case of rough weather the pipe, if it should tend to leave the rails, cannot get outside of this chute. The angle of this apron with the horizontal not to exceed 30 degrees. The lower end or shoe of the apron to be flattened out to a smooth, long, rounding shoe, so as to slide along smoothly and not to plow too deep a furrow into the bottom of the bay. The apron should not be less than 12 ft. in width, properly braced diagonally against side vibration, planked with 3 in. plank, and properly strengthened on the two outer edges by timber or iron trusses, so as to make the entire structure rigid and amply strong for the purpose intended. The upper end of the incline apron to project on the same incline above the deck of the barge to a height sufficient to show not less than 30 ft. (measured along the incline) above the surface of the water. The apron where it strikes the edge of the barge to be so fastened to the same that in rough weather it has ample play to let the lower iron-mounted side of the apron play and slide on heavy iron rolls, firmly fixed near the edge of the scow, but the apron so fastened with double extra heavy wrought iron chains and extra safety chains, that the apron has sufficient up and down and side play in case of rough weather.

As the crucible steel wire cable which is used for lowering the pipe passes over a heavy grooved pulley fixed on the upper projecting end, and is the center line of the apron, the up and down movement of the barge will not interfere with the steady lowering of the pipe.

The bell end of the pipe (being upwards) is fastened to the apron by strong chains and chain tackle, and by an extra safety chain with plenty of slack, fastened to the barge.

The next pipe is hoisted up on to the rails with bell up; then fastened to the lowering hook. Then a strip of clay putty is pressed on the inner and lower edge of the bell in which the joint is to be made.

The bell is wiped out clean with a greased rag; the upper pipe is carefully entered, and by its own weight and on extra prying the lower bevelled end of the nipple is pressed tightly into the above clay packing in the lower end of the bell (so as to make it absolutely tight against lead leakage); then the clay sausage is packed tightly around the entered pipe and against the face of the bell, building up a clay reservoir on top for receiving the hot lead and allowing the gases to escape.

The lead pot is hoisted up (the lead being heated to a yellow straw-color and slag removed); a little tallow is put into the clay reservoir for flux and the lead is poured in with a steady stream until the entire joint is filled. When the lead is hardened, the clay is removed, the big projections of the lead cut off and the lead joint properly caulked home, so as to show a square, solid, smooth face. The lowering cable is now brought up tight, the safety catch fastened back of the upper bell, the lower chain tackle slacked and unhooked, and at the same ratio as the barge is slowly and steadily pulled ahead (in a straight line), the pipe is allowed to slide along the rails of apron. A sufficient strain is meanwhile kept on the lowering cable, so that none of the joints on the lower and suspended portion of the pipe deflect more than ten degrees, so that only from three to four pipes at most, where they leave the lower portion of the apron, are suspended at any given time.

The windlass pulling the barge ahead on a steel cable of ample strength stretched across the bay, from shore to shore, which is weighted at intervals, so as to remain on the bottom and not interfere with navigation. During the entire process of laying the pipe, the barge is kept in its perfectly straight line and uninfluenced by wind or tides by four heavy anchors and cables—two on the port and two on the starboard side—placed from 50 to 75 fathoms away from the barge. (For ball-joint see drawing).

**2d.** The contractor is also required to bid on the following plan of submarine pipe: Instead of cast-iron, the pipe to consist of first-class lap-welded tubing, 16 in. in the clear in diameter, of $\frac{1}{4}$ in. or $\frac{5}{16}$ in. best wrought-iron, of a tensile strength of not less than 50,000 lbs. The lap or weld to be as perfect as regards strength and tightness as the solid iron.

The pipes to be thoroughly covered in and outside by a first-class covering of zinc galvanizing.

The bells and nipples to be of first-class cast-iron, of same material and workmanship as required for above mentioned cast-iron pipe, and thoroughly and tightly riveted to the tubing, and the same split and caulked against the casting. In this case the bell is cast hollow and not turned out, except the lower level and the entrance opening for the nipple-ball, there being 0.20 in. total play, or a radial play of $\frac{1}{10}$ in. all around the ball end.

The ball is turned off to a perfect sphere, perfectly smooth, each pipe complete to be tested to 200 lbs. pressure per square inch.

All pipes showing splits, leaks, flaws or bad workmanship, to be rejected.

The process of making joints and lowering pipe to be like the one above described for the cast iron pipe. The contractor to bid for a double line of this 16 in. pipe.

As this pipe is very light compared with the above cast-iron pipe, it is possible to lay both pipes at the same time, provided the apron is widened to 16 or 18 feet, so that the two pipes will lay no nearer than 12 or 14 ft. from center to center. The Spring Valley Water Works will paint or coat the pipes at their own expense with a coating that they consider the best proof against salt water corrosion.

3d. The contractor is also required to bid on the final and third plan of submarine pipe. The submarine line to consist of one wrought iron pipe made of straight courses of $\frac{5}{16}$ boiler iron, best quality, same as above.

Bells and ball ends (according to drawing) to be made and riveted on with the same perfect workmanship as specified for the 16 in. tubing.

Rivets to be $\frac{5}{8}$ in., straight seams double, round seams single riveted, of such proportions and distances apart and laps as is specified for the best of boiler work.

All edges of plates on outside of pipe thoroughly chipped and caulked. Process of laying same as heretofore described.

The Spring Valley Water Works will paint or coat the pipe with their own coating at their own expense.

All pipes to be tested to 200 lbs. pressure, and all pipes showing flaws or bad workmanship to be rejected.

## H.

### Inlet and Outlet Gates for Submarine Pipes.

The contractor to provide and attach, both at the easterly and westerly terminus of the submarine pipe, two first-class 16 in. gates, of best approved Spring Valley pattern, in case the double 16 in. line is adopted, or one first-class 22 in. gate of same pattern at each end of said pipe, provided the one 22 in. line is adopted.

The contractor also to provide and attach, at either bay end of the 36 in. pipe, a 12 in. first-class blow-off gate of above pattern, and for the terminus of the 36 in. pipe on the east side of the bay a 16 in. balanced safety valve, that will prevent any and all shocks and concussions on said easterly section of the 36 in. pipe in case the easterly gate or gates on the submarine pipes are being shut off.

The Spring Valley Water Works to furnish all the iron and rivets required for the 36 in. pipe, also to do all the dipping, coating and painting of the 36 in. wrought-iron and the two 16 in. or one 22 in. wrought-iron submarine pipes, and the painting of the riveted joints in the ditch on the 36 in. pipe.

The contractor, at his own expense, to furnish all materials and labor for cast or wrought-iron submarine pipes, to make and lay the same, also make and attach all fittings, as gates, blow-offs, air-valves, man-holes, safety-valves, etc.; also to dig the ditch, to transport and lay and connect the pipes and to fill the ditch, all of which as above described.

In short, the contractor is to construct a continuous conduit as above described, which connects the above mentioned stone aqueduct near Vallejo's Mill with the Spring Valley Water Works 44-in. pipe near San Mateo, in every way in most perfect and workmanlike manner.

The entire work herein specified to be finished according to the above specifications and in complete working order on or before March 1st, 1888.

The bidder to state his price per lineal foot separately.

1. For manufacturing the 36 in. pipe of No. 9 iron and No. 7 iron, per lineal foot.

2. For laying and connecting the same in the ditch and on the bridges and trestle works.

3. For digging the ditch, per cubic yard.

4. For digging the joint-holes, per each joint-hole.
5. For filling the ditch.
6. For transporting the pipe to and along the ditch.
7. For constructing the trestle-work.
8. For manufacturing and attaching by the piece:

   a. Manhole.
   b. Air-valves.
   c. Blow-offs.
   d. Blow-off gates.
   e. Gates for submarine pipes.
   f. Safety-valves, near east end of submarine pipes.

The bidder furthermore to bid—

9. For the furnishing of the above specified three kinds of submarine pipes, complete, with joints, as specified.

10. For the transporting, testing and laying of the same across the bay, on the line specified and connecting them at the two termini with the 36 in. pipe.

Finally, the bidder to state the sum total for which he will construct the entire conduit complete in running order and ready for service, according to the above specifications and in the specified time.

The payments for the above work to be made as follows: 50 per cent. of the contract price to be paid to the contractor at the end of each month for pipe delivered; 25 per cent. additional to be paid for every one (1) mile of pipe laid and riveted together in the ditch with all connections and attachments complete. The remaining 25 per cent. to be paid after the entire pipe has stood the test under full working pressure for sixty (60) consecutive days to the entire satisfaction of the said party of the first part and its agents.

Should heavy rains occur during the time specified for the completion of the pipe, which will delay the laying of the same, the Company will extend the time for its completion to correspond to the time so lost.

Bids to be handed into the office of the Spring Valley Water Works before July 20th, 10 o'clock A.M., 1887.